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GREAT BARRIER REEF EXPEDITION
1928–29

VOLUME IV

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION
1928–29

SCIENTIFIC REPORTS

VOLUME IV

POLYCHAETA, OLIGOCHAETA, ECHIUROIDEA and SIPUNCULOIDEA
ENTEROPNEUSTA
TUNICATA
AMPHIPODA
THE ALCYONARIAN FAMILY XENIIDAE, Etc.
HYDROIDA
ECHINODERMATA (other than ASTEROIDEA)
ASTEROIDEA
FISHES
SIPHONOPHORA
STOMATOPOD LARVAE, CUMACEA and CLADOCERA
THE POLYZOA, with a Note on an Associated HYDROID
GORGONACEA
SPONGES
THE SILICOFLAGELLATA and TINTINNOINEA

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. Quaritch, Ltd., 11, Grafton Street, New Bond Street, London, W.1; Dulau & Co., Ltd., 29, Dover Street, London, W.1; Oxford University Press, Warwick Square, London, E.C.4
and at
The British Museum (Natural History), Cromwell Road, London, S.W.7

1931–1934

Made and printed in Great Britain.

Adlard & Son, Ltd., 21, Hart Street, W.C. 1.

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INVESTIGATIONS

POLYCHAETA, OLIGOCHAETA, ECHIUROIDEA, AND SIPUNCULOIDEA

BY

C. C. A. MONRO, M.A.,
Assistant Keeper in the Department of Zoology.

WITH FIFTEEN TEXT-FIGURES

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POLYCHAETA.

INTRODUCTION.

This report deals with benthic species only; the pelagic species collected by the Expedition will be described in a later publication. The specimens in this collection were obtained from various points on the Great Barrier Reef, the majority from Low Isles (lat. 16° 23′S.). Those collected in the course of the ecological survey of Low Isles and the neighbouring reefs have in the locality lists after the words "Gen. survey" and the date a place-name or a symbol referring to the key-chart given in Dr. Stephenson's report on the ecological survey. Dredged or trawled specimens have a station-number, and the name of the boat in which they were obtained preceding their specifications of locality. A full account of the stations and the apparatus used is contained in Dr. C. M. Yonge's report on the conduct of the expedition.

LIST OF SPECIES:

Family Amphinomidae.
Eurythoe complanata (Pallas).

Family Aphroditidae.
Pontogenia villosa, Horst.

Family Polynoidae.
Thormora johnstoni (Kinberg).
Lepidonotus stephensoni, n. sp.
Lepidasthenia terrae-reginae, n. sp.
Gastrolepidia clavigera, Schmarda.
Iphione muricata (Savigny).

Family Sigalionidae.
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Sthenelais malayana, Horst.

Family Polyodontidae.
Polyodontes melanonotus (Grube).

Family Phyllodocidae.
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Family Hesionidae.
Hesione intertexta, Grube.
Hesione genetta, Grube.
Hesione ? splendida, Savigny.
Leocrates chinensis, Kinberg.

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Family Nereidae.
Nereis unifasciata, Willey.
Perinereis nancaurica (Ehlers).
Perinereis helleri, Grube.
Perinereis camiguina, Grube.
Perinereis nigropunctata, Horst.
Perinereis obfuscata, Grube.
Platynereis polyscalma, Chamberlin.
Ceratonereis tentaculata, Kinberg.

Family Glyceridae.
Glycera gigantea, Quatrefages.
Goniada tripartita, n. sp.

Family Eunicidae.
Eunice antennata, Savigny.
Eunice grubei, Gravier.
Eunice aphroditois (Pallas).
Eunice afra, Peters.
Marphysa mossambica, Peters.
Lysidice collaris, Grube.
Onuphis, sp.
Arabella longipedata, n. sp.

Family Spionidae.
Scolelepis indica, Fauvel.

Family Chaetopteridae.
Mesochaetopterus minuta, Potts.

Family Opheliidae.
Armandia lanceolata, Willey.

Family Capitellidae.
Dasybranchethus fauveli, gen. et sp. nov.
Dasybranchus, sp.

Family Amphictenidae.
Pectinaria (*Pectinaria*) *brevispinis*, Grube.
Pectinaria (*Pectinaria*) *antipoda*, Schmarda.

Family Terebellidae.
Loimia medusa (Savigny).
Loimia montagui (Grube).
Pista typha (Grube).

Family Serpulidae.
Spirobranchus giganteus (Pallas).
Salmacina dysteri (Huxley).

There are 46 species, of which 5 are new; one of the latter is the genotype of a new genus of Capitellids. *Pontogenia villosa*, Horst, is a curious form, very close to *Aphrodite*.

The heteronereid of *Perinereis obfuscata*, Grube, is new, and I have been able to add to the number of records of the aberrant heteronereid *Platynereis polyscalma*, Chamberlin, the atocous form of which is not known.

SYSTEMATIC ACCOUNT.

Family AMPHINOMIDAE.

Eurythoe complanata (Pallas).

Chamberlin, 1919, p. 28, for synonymy.

Occurrence.—Low Isles, Gen. survey; 6.xii.28, sand flat, "Under stones" (1).—28.iii.29, "Mangrove Park" (1).

4.iv.29, F. 6, "Dug up in sandbank near oyster-pen" (1).—11.iv.29, "Between anchorage reefs and Tripneustes Spit" (1).

Low Isles, "From rocks" (1); Low Isles (2); Batt Reef (3).

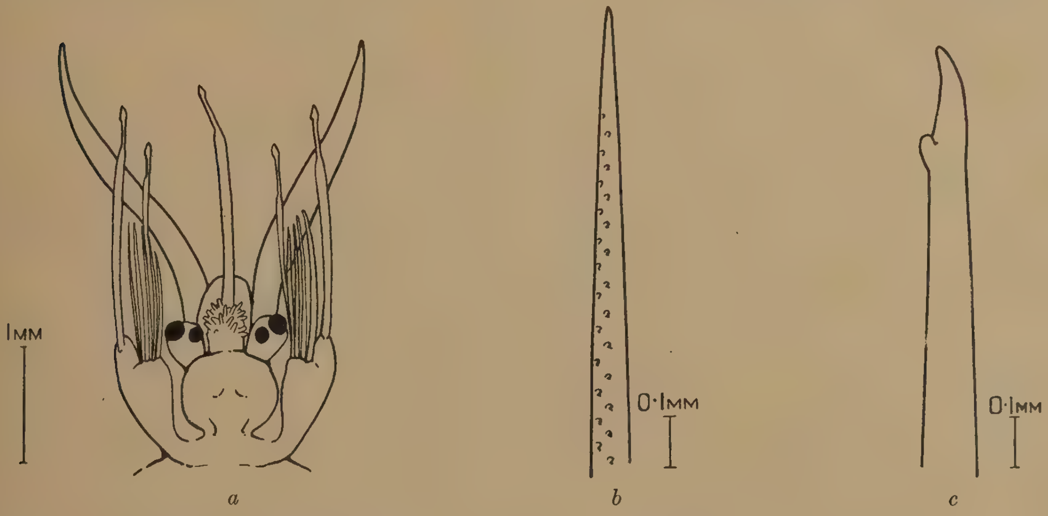
Family APHRODITIDAE.

Pontogenia villosa, Horst.

Horst, 1917, p. 139, figs. 1 and 2.

Occurrence.—Low Isles, "From rocks" (1).

REMARKS.—The specimen measures 26 mm. by 10 mm. for 34 chaetigers. The thick dorsal felting gives it the appearance of an *Aphrodite*, from which it is distinguished by the presence of eye-stalks and clearly bifid ventral bristles. The eye-stalks (Text-fig. 1*a*) are about half as long as the prostomium and each carries a pair of eyes at its tip; the dorsal member of each pair of eyes is rounded and the ventral oblong, and twice the size of the dorsal. The median tentaculophore is slightly longer than the eye-stalks and its tentacle is more than twice its length. The palps and the dorsal tentacular cirri are about the same length as the median tentacle; the ventral tentacular cirri are slightly shorter.



TEXT-FIG. 1.—*Pontogenia villosa*. *a*, head; *b*, dorsal bristle; *c*, ventral bristle.

The dorsal cirri are completely concealed by the felting; they are about the same length as the dorsal bristles and end in a clavate tip. The ventral cirri are very short, scarcely reaching to the bases of the ventral bristles.

The brown dorsal bristles (Text-fig. 1*b*) are directed fanwise upwards and backwards; they are almost wholly hidden by the dorsal felting. They are very slightly curved, and on one edge are furnished with two rows of small alternating tubercles. The ventral bristles (Text-fig. 1*c*) are four in number and are more clearly bifid than those in Horst's type-specimen.

The dorsal felting consists of three kinds of bristles: (1) Very long slender yellow capillary bristles; (2) colourless bristles, about half as stout as the preceding; (3) minute microscopic hairs. I cannot see the articulated appearance attributed by Horst to the intermediate type of felting bristle.

I believe the only other record of this species is the original one from the Malay Archipelago.

Family Polynoidae.

Thormora johnstoni (Kinberg).

Monro, 1928B, p. 467.
Thormora jukesi, Baird, auctorum.

Occurrence.—Low Isles (1).

Remarks.—This specimen closely resembles those I described (*loc. cit.*) from Tahiti and the Marquesas.

Lepidonotus stephensoni, n. sp.

Occurrence.—Low Isles (1).

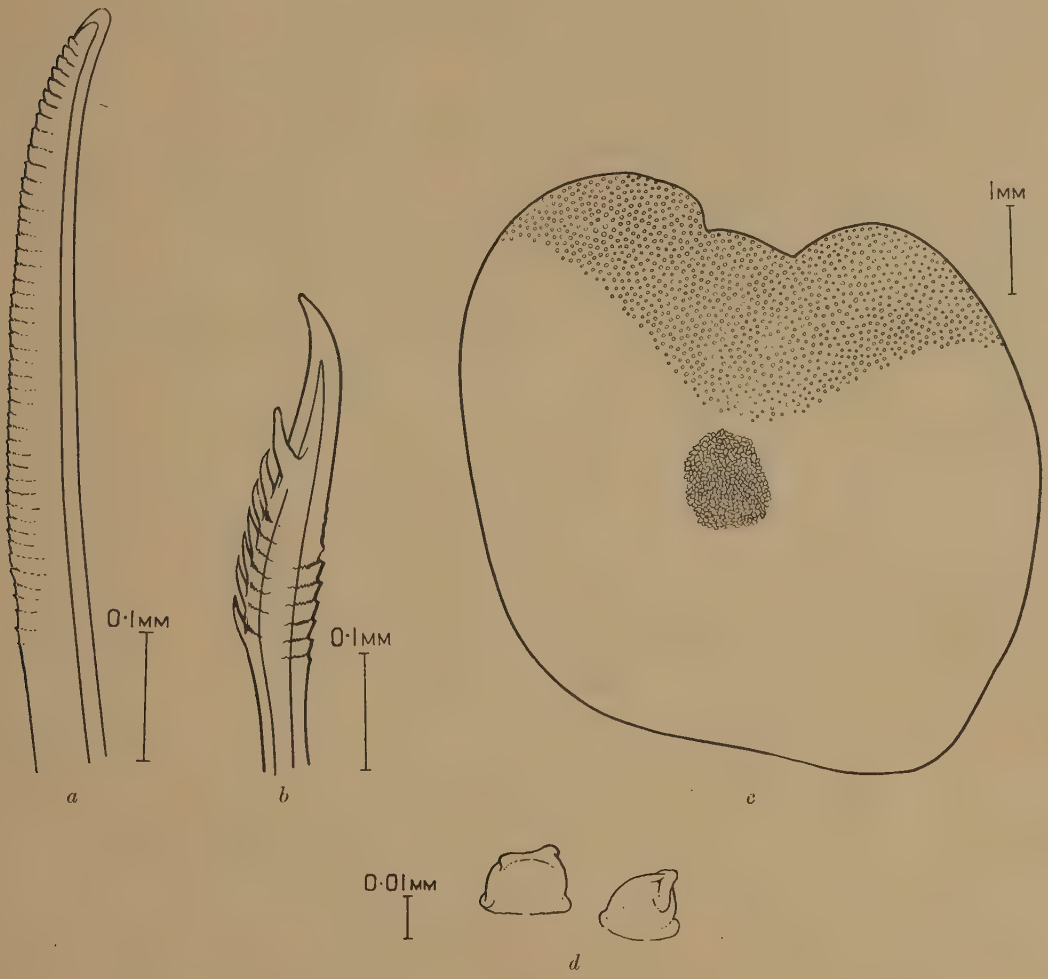
Description.—The example measures 30 mm. by 5 mm. without the feet for 25 chaetigers. The large flesh-coloured elytra with a dark spot over the scar of attachment give this specimen a very close resemblance to the *L. oculatus* of Baird. It has a typical *Lepidonotus* head, and the tentacles, palps, tentacular cirri and the ventral cirrus of the first chaetiger are all of about the same length—approximately three times as long as the head. The tentacles and cirri are claviform and have a small thread-like terminal appendage. The dorsal cirri extend beyond the tips of the bristles and the ventral just reach to the end of the foot.

The structure of the bristles and feet is very similar to that of *L. oculatus*, of which Fauvel (1917, p. 171, pl. iv, figs. 20–23) gives a good account. The finely striated dorsal bristles (Text-fig. 2*a*) are fewer than in Baird's species, being only about four in number. They are very like the bristle of *L. oculatus* figured by Monro (1928A, p. 313). In the ventral bristles (Text-fig. 2*b*) the rows of spinules terminate distally in a large tooth; but the apex is unidentate. So far this species is indistinguishable from *L. oculatus*.

It is, however, the structure of the elytra (Text-fig. 2*c*) that distinguishes this from Baird's species.

The characteristic mushroom-shaped tubercles of *L. oculatus* are absent.

The anterior border of the scale is slightly emarginate, and between it and the scar of attachment the scale is dotted with small semi-oval tubercles (Text-fig. 2*d*), similar to those described and figured for *L. hedleyi* by Benham (1915, p. 181, pl. xxxviii, fig. 3) and by Pruvot (1930, p. 7, pl. i, fig. 9). The scales have no fringe and the pigment is confined to the scar of attachment, where, under the microscope, the granules have a reticular appearance.

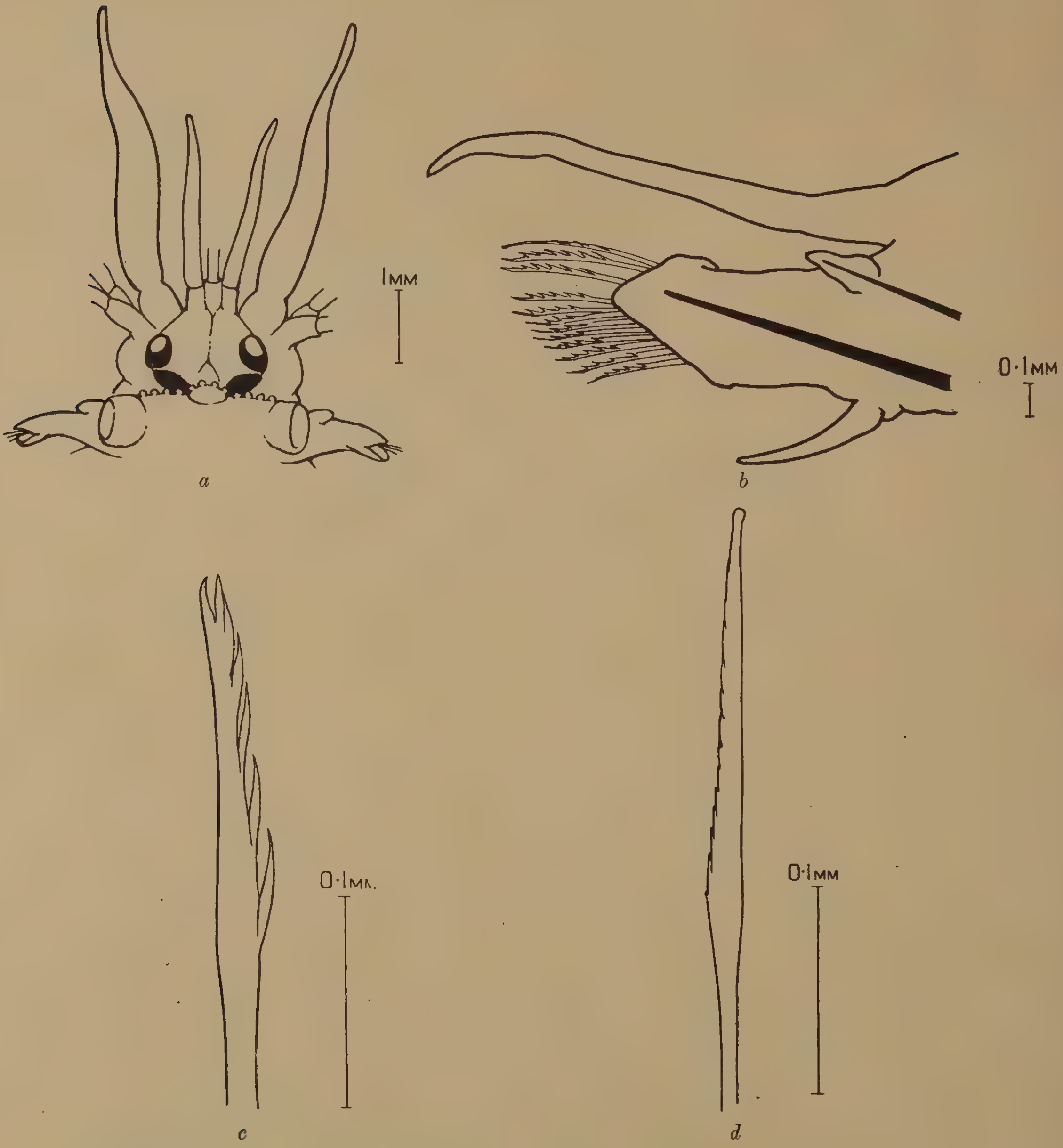


Text-fig. 2.—*Lepidonotus stephensoni*. *a*, dorsal bristle ; *b*, ventral bristle ; *c*, scale ; *d*, tubercles on the scale.

Remarks.—This form combines in a curious manner the characters of *L. oculatus* and *L. hedleyi*, resembling the former in everything except the elytral tubercles, which are like those of *L. hedleyi*. In the present state of our knowledge of the relations of Baird's and Benham's species I have no choice but to establish a new species. It belongs to the group of Lepidonotids with unfringed elytra and unidentate ventral bristles. *L. argus*, *L. australiensis*, *L. impatiens* and *L. javanicus* belong to the same group of species, but differ in the nature of the bristles and the tuberculation of the elytra.

Lepidasthenia terrae-reginae, n. sp.

Occurrence.—Low Isles (2).



Text-fig. 3.—*Lepidasthenia terrae-reginae.* *a*, head; *b*, anterior foot; *c*, normal bristle from 17th foot; *d*, dorsalmost bristle of 17th foot.

Description.—The body is long and vermiform, the larger specimen measuring 49 mm. by 2 mm. without the feet for 80 chaetigers. In spirit the colour is confined to two rows of brown spots, one on each side of the back above the feet; there is also a small brown spot on every elytron just median to the scar of attachment. Both specimens are incomplete posteriorly. The head is bilobed and broader than long (Text-fig. 3*a*). There are two pairs of round, contiguous, laterally situated eyes. The palps are stout tapering structures, which, when laid along the back, reach to the 6th chaetiger. The median terminally inserted tentacle is lost, as are also the tentacular cirri. Behind the head is a crescentic nuchal flap or gibbosity, the margin of which carries four papillae ; and on each side of the nuchal organ there is a row of four papillae reaching to the bases of the first pair of elytrophores.

The arrangement of the elytra is as usual in the genus ; they are quite smooth, transparent and unfringed ; they are rather larger than in most of the species of the genus.

The dorsal cirri reach well beyond the tips of the bristles ; the ventral cirri arise half-way down the feet and are about one third of their length. The feet (Text-fig. 3*b*) are very long, being, without the bristles, equal in length to the breadth of the back. They are clearly biramous, the notopodium being represented by a distinct lobe, supported by an aciculum ; there are no notopodial bristles. The neuropodium carries about twenty bidentate bristles of the usual *Lepidasthenia* kind, with about seven rows of teeth (Text-fig. 3*c*). Of these bristles the more dorsal are slightly longer and more slender than the ventral and have the separation of the two terminal teeth more clearly marked. In addition, for about the first twenty chaetigers there is a pair of longer and more delicate bristles situated dorsally to the rest ; these dorsal bristles (Text-fig. 3*d*) have an undivided tip and are very faintly toothed throughout the greater part of their length. They disappear by the 30th chaetiger.

REMARKS.—The presence of a papillated nuchal flap distinguishes this species from all the other members of the genus except *L. michaelseni*, Augener, from south-west Australia. It differs from that species in having a much smaller nuchal organ, a more prominent notopodium and no unidentate dorsal bristles behind the 30th chaetiger.

Gastrolepidia clavigera, Schmarda.

Pruvot, 1930, p. 13, pl. i, figs. 16–19, with synonymy.

OCCURRENCE.—Low Isles ; Gen. survey ; 10.iv.29, A4 (1).

Low Isles (1), Batt Reef (1), " Locality unknown " (2).

Iphione muricata (Savigny).

Fauvel, 1930, p. 509.

OCCURRENCE.—Low Isles, Gen. survey ; 19.xi.18, sand flat, " Under stones " (1).—22.iii.29, RD and R16 (1).—28.iii.29, G.3 (1).—4.iv.29, F.9 (1).—5.iv.29, I.M.4 and I.M.5 (1), " Between Madrepore Moat and Mangrove Park " (5).—" The Thalamita Flat " (1).

St. 14. " Magneta." 7.iii.29, ½ mile S.E. Lizard Island, 19 fms. Bottom shell gravel ; rich *Halimeda* (1).

St. 17. " Magneta." 9.iii.29, about ¼ mile N. of N. Direction Island, 19 fms. Bottom sand ; thick *Halimeda* (1).

Low Isles (6).

Family Sigalionidae.

Sthenelais variabilis, var. *glabra*, Potts.

Potts, 1910, p. 349, pl. xix, figs. 22–23, pl. xxi, fig. 63.
Sthenelais variabilis, Horst, 1917, p. 111, pl. xxii, fig. 6.

Occurrence.—St. 5, "Merinda," 24.xi.28, Linden Bank, 37 fms.; bottom mud; Agassiz trawl (3).

Remarks.—Three rather ill-preserved fragments, of which only one retains any scales. They correspond to Potts's account of the smooth variety of this species, except that the reduction of the tubercles on the elytra has gone a stage further, and all but the most anterior elytra are without tubercles; as in Potts's figure, the external border has a few large papillae. I can confirm Potts's observation that in several feet from the same specimen the simple upper neuropodial spinose bristles may be present, or they may be replaced by compound bristles with long, very slender jointed blades; in these the head of the shaft is usually denticulated. The most frequent condition is that both the simple spinose and the slender compound bristles are present in the upper part of the neuropodium.

There are three ctenidia. The number of stylodes appears to vary from one foot to another. In a number of feet I have seen a group of about 5 stylodes in the notopodium lying above the bristles, one or two in the middle of the neuropodium and two at the base of the feet.

Sthenelais malayana, Horst.

Horst, 1917, p. 114, pl. xxiii, figs. 7–9.

Occurrence.—West of Low Isles, 15.xi.28, 8 fms; bottom mud (1).

Remarks.—A single anterior fragment belonging to this species. The anterior end is infested with a small Polyzoan, probably the "? rotatoria" of Horst's account. The scales are thickly dotted with small semicircular tubercles and the external margin has a few long papillae; the number of papillae is considerably less than that in Horst's figure.

The slender compound neuropodial bristles lying just below the simple spinose neuropodial bristles have very long delicate terminal articles, and in these the bifid tips are often very difficult to see. In the more ventral upper neuropodial bristles the bifid tips are usually more clearly visible. The articulations of the appendix in the multi-articulate bristles are very much less distinct than in *S. variabilis*. Horst gives three as the number of ventral bristles with a single-jointed appendix; in this specimen there are at least six.

Family Polyodontidae.

Polyodontes melanonotus (Grube).

Panthalis melanonotus, Grube, 1878, p. 48, pl. iv, fig. 1.
Panthalis melanonotus, Fauvel, 1919, p. 339, pl. xv, figs. 1–3, pl. xvii, figs. 70–75, with synonymy.

Occurrence.—West side of Low Isles, 8 fms.; mixed bottom (1).

Remarks.—A single anterior fragment of 33 chaetigers. Fauvel has given a full account of this species. The scales have a narrow black border interrupted where the edge is reflexed to form a pouch.

The first foot is not extended, as in Fauvel's figure, but much contracted; it resembles that figured by Horst (1917, pl. xxviii, fig. 7) for his *Polyodontes sibogae*, which Fauvel regards as identical with Grube's species. The feet are rugose and I cannot with certainty distinguish any branchial papillae. In the allied *P. mortenseni*, Monro, the elytra are not areolated as they are in the present species.

Family PHYLLODOCIDAE.

Phyllodoce malmgreni, Gravier.

Gravier, 1900, p. 207, pl. x, figs. 29–31, text-figs. 66–69.
Fauvel, 1919, p. 360.

OCCURRENCE.—Low Isles, Gen. survey ; 20.iv.29, " The Sand Flat " (1).

REMARKS.—A very long, slender, much-coiled specimen about 2 mm. in breadth. The dorsal median stripe is continuous for about the first 50 chaetigers, and then interrupted by segmental ridges joining the feet across the body : there are no intersegmental interruptions. I can see no nuchal papilla. The pharynx is not everted ; the oral region is covered with small papillae ; the aboral region has six longitudinal ridges, each divided into eight or nine large wart-like papillae. I have not dissected the third tentacular segment, but under a binocular I can see no chaetae.

The dorsal cirri in the middle feet are subrectangular.

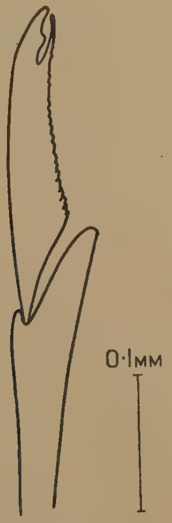
This is the first record of this species from Australian waters. Gravier records it from the Red Sea, Fauvel from Madagascar, and Augener from New Pomerania.

Family HESIONIDAE.

Hesione intertexta, Grube.

Monro, 1926, p. 311.

OCCURRENCE.—Low Isles ; 20.xi.28 (1).



TEXT-FIG. 4.—*Hesione intertexta*. Bristle.

St. 14. "Magneta." 7.iii.29; ½ mile S.E. Lizard Island, 19 fms.; bottom shell gravel; rich *Halimeda* (2).

St. 17. "Magneta." 9.iii.29; about ¼ mile N. of N. Direction Island, 19 fms.; bottom sand; thick *Halimeda* (2).

Low Isles (4).

REMARKS.—This species has brown stripey markings, and in the bristles the accessory tooth of the chaetal guard approaches the apical tooth (Text-fig. 4*a*).

Fauvel does not attach any differential importance to differences in colour in *Hesione*, and regards the relation of the chaetal guard to the apical teeth as being too subject to changes due to age and wear to be of any value as a specific character. He suggests that most of the species of *Hesione* described from the Indo-Pacific belong to the European *H. pantherina* Risso, which is probably the same as the imperfectly characterized *H. splendida* Savigny.

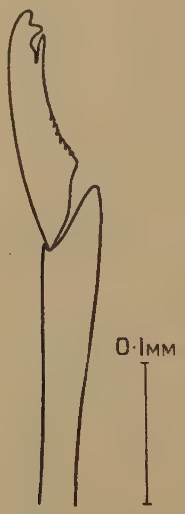
Having examined the present material, I see no reason to alter my opinion that when all allowances have been made for changes due to wear, etc., the relation of the chaetal guard to the apical teeth is of value as a specific differential. However, in the example attributed by me to *H. splendida* because of its lack of definite colour markings (*v.* Pruvot, 1930, p. 29), the absence of the chaetal guard would seem to substantiate Fauvel's view, if, as I have assumed, this absence is due to wear.

Between the examples of *H. intertexta* and *H. genetta* there is a definite difference in the length of the accessory tooth of the chaetal guard, associated with extreme differences in colour-pattern.

Hesione genetta Grube.

Horst, 1924, p. 193.

OCCURRENCE.—Low Isles (3).



TEXT-FIG. 5.—*Hesione genetta.* Bristle.

REMARKS.—This species has the back covered with purple spots, and a transverse band of white between the 2nd and 3rd chaetigers. In the bristles the accessory tooth of the guard approaches the subapical tooth (Text-fig. 5*a*).

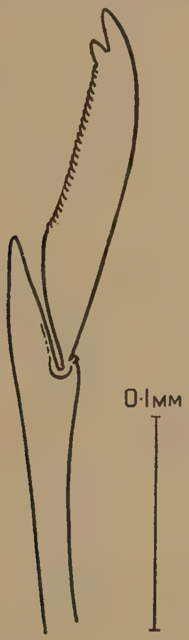
Hesione ? splendida, Savigny.

Pruvot, 1930, p. 27.

Occurrence.—Jukes Reef (1).

Description.—A single well-preserved specimen measuring 54 mm. by 5 mm. for 16 chaetigers is referred, with some doubt, to this species.

The specimen is flesh-coloured in spirit, and in each segment there is a square dorsal mark paler in colour than the rest of the body. On each side of the body just above the feet there is a series of thickened, probably glandular pads. Anteriorly the shape of the head is difficult to interpret owing to the distortion caused by the partial extrusion of the pharynx. It is roughly cordiform, and I can see no anterior indentation of the prostomium. There is no trace of palps, and the usual pair of very small tentacles is present. There are two pairs of lateral eyes, of which the anterior is the larger. There are eight pairs of long tentacular cirri, the longest reaching back to the middle of the 2nd chaetiger.



Text-fig. 6.—*Hesione splendida.* Bristle.

Except for the one or two small bristles within the bases of the dorsal cirri the parapodia are uniramous. The dorsal cirri are very long and indistinctly annulated; when laid across the back they reach beyond the mid-dorsal line. The ventral cirri are more distinctly annulated and reach to the tips of the bristles. The terminal segment is achaetous and its pedal lobes lying up against the anus send out two pairs of anal tentacular cirri. There is also a pair of long anal cirri in the median line.

The feet are cylindrical and supported by a single black aciculum; they end in a pair of vertical lips from which there issue dorsally two finger-shaped retractile processes, and below these the neuropodial bristles.

These bristles are compound bidentate chaetae of the usual Hesionid kind except that after a prolonged and careful search I cannot find any trace of a chaetal guard on the blades (Text-fig. 6*a*).

It is impossible to decide whether the absence of the guard is due to wear, etc., or whether it is a natural feature. If it be natural, a new species should be established for this specimen; the present material is, however, insufficient to warrant the assumption that there is a species of *Hesione* without chaetal guards. Except for the absence of the latter, the specimen agrees well with the example from New Caledonia attributed to Savigny's species by Pruvot.

Leocrates chinensis, Kinberg.

Horst, 1924, p. 193.

Leocrates anonymus, Hessle, 1925, p. 15, fig. 4.

Occurrence.—St. 17. "Magneta." 9.iii.29; about ¼ mile N. of N. Direction Island, 19 fms. Bottom sand. Thick *Halimeda*. Dredge (1).

Remarks.—This species is easily recognizable by its large facial tubercle.

Family Syllidae.

Odontosyllis hyalina, Grube.

Grube, 1878, p. 129, pl. vii, fig. 1.
Augener, 1913, p. 238.

Occurrence.—Low Isles; 3.x.28. "Caught in lagoon after dark. Phosphorescent" (2).

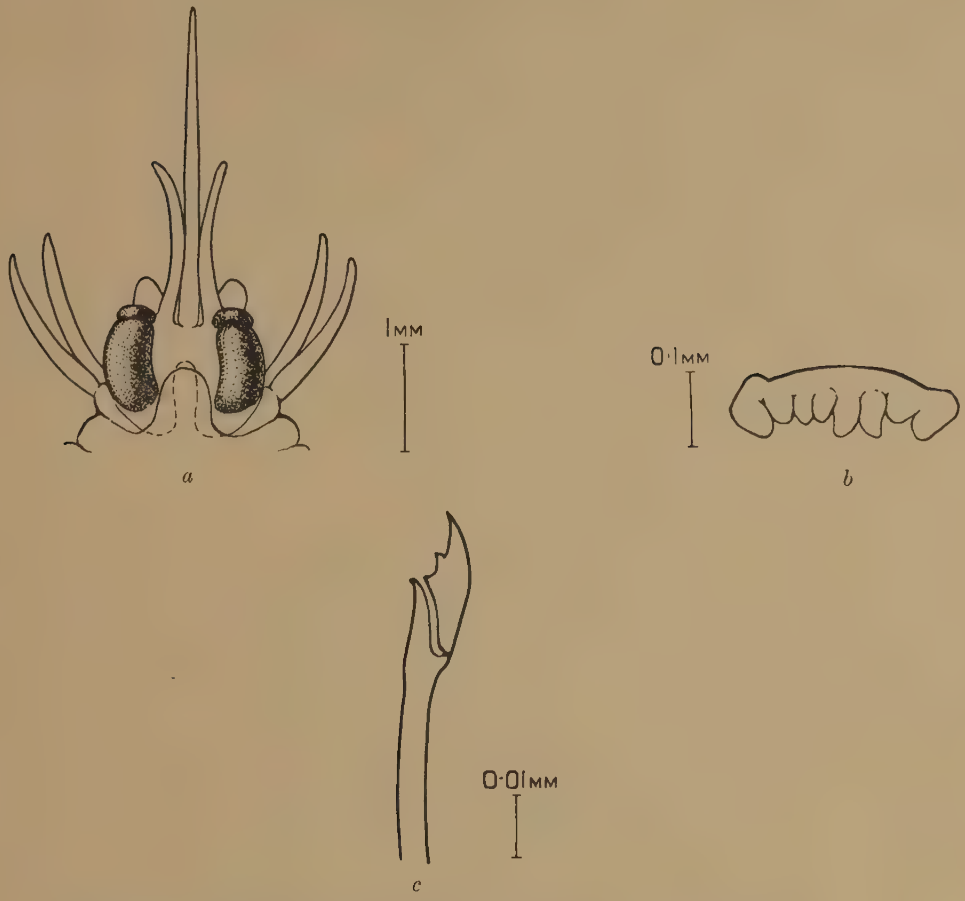
Remarks.—Two specimens broken into a number of fragments. The breadth is 2 mm. including the feet. They are colourless except for the eyes and in an epitocous condition. There is no trace of stolonization.

The head (Text-fig. 7*a*) is divided behind by a deep groove, to the front end of which the occipital gibbosity reaches. There are two pairs of enormous brown eyes, fused into a single mass. The anterior pair is directed forwards and the posterior upwards.

The palps are fused at their base and rather prominent. The lateral tentacles are slightly longer than the head, and the median tentacle is twice as long as the laterals. The dorsal cirri are slender cylindrical structures, alternately longer and shorter; they reach well beyond the tips of the bristles. The ventral cirri are short conical organs reaching to the end of the pedal lobe.

The pharynx reaches to the 7th chaetiger and the proventriculus to the 17th. The pharynx is armed with eight teeth (Text-fig. 7*b*), two large lateral teeth and six smaller teeth between them. The bristles have very short bidentate blades, with the subapical tooth occurring about halfway down the blade (Text-fig. 7*c*). The swimming-bristles begin on the 34th chaetiger. I can see no trace of the pigmentation of the nephridia described by Grube. Augener has supplemented and modified Grube's original account of this species, but has added no figures.

Grube mentions the fact that it is phosphorescent.



TEXT-FIG. 7.—*Odontosyllis hyalina.* *a*, head ; *b*, teeth ; *c*, compound bristle.

Family NEREIDAE.

Nereis unifasciata, Willey.

Horst, 1924, p. 153, pl. xxxi, figs. 3 and 4, with synonymy.

OCCURRENCE.—Low Isles ; Gen. survey ; 28.iii.29. " Mangrove Park " (1).

REMARKS.—A single specimen doubtfully attributable to this species. It is incomplete, and measures 11 mm. by 2 mm. without the feet for 20 chaetigers, the last three of which are destroyed, so that, although the specimen is a ripe female, I cannot tell whether there is an epigamous change at the 19th chaetiger such as is recorded by Horst for his specimens. The specimen is colourless except for the three dark glandular marks on the ligules of the feet. The proboscis is not everted, but the arrangement of the paragnaths agrees with that given by Horst and other authors. I find that the ventral lobe of the foot extends about as far as the lower notopodial ligule and is longer than the ventral ligule. Willey figures the ventral ligule longer than the ventral lobe and Horst describes them as of about the same length. The heterogomph spinigers of the lower ventral bundle are not fully heterogomph.

Perinereis nancaurica (Ehlers).

Nereis vancaurica, Ehlers, 1864–68, p. xx (Vorrede).
Grube, 1878, p. 83.
Nereis languida, Grube, 1867, p. 15, pl. ii, fig. 1, *a–b*.
Non *Nereis languida*, Kinberg, 1865, p. 169.
Nereis (Perinereis) nancaurica, Ehlers, Augener, 1922, p. 23.

Occurrence.—Low Isles; 7.iii.29 (1).

Remarks.—The specimen measures 53 mm. by 3 mm. without the feet for 115 chaetigers. The species is distinguished by the presence of paired linear paragnaths in Group VI, and of very numerous, minute paragnaths on the maxillary ring. The maxillae have no secondary teeth. The proboscis is not everted, and I cannot give a detailed account of the number and arrangement of the paragnaths. The feet agree with Grube's figure. The arrangement of the bristles is as follows:

Notopodium: Homogomph spinigers.
Neuropodium: *Upper bundle:* Homogomph spinigers and heterogomph falcigers.
Lower bundle: Heterogomph spinigers and heterogomph falcigers.

There seems to be some confusion as to the origin and spelling of the specific name of this species. Grube (*loc. cit.*, 1878) refers it to p. 503 of Ehlers's 'Borstenwürmer': this is a mistake, as there is no mention of the name on that page. Actually the name is first used by Ehlers on p. xx of the *Vorrede* of his 'Borstenwürmer,' in which he points out that the name *languida* used by Grube for his species in 1867 is preoccupied by the *Nereis languida* of Kinberg 1865, Kinberg's species being distinct from that of Grube. Ehlers substitutes the name *vancaurica* for the *languida* of Grube, *Vancauri* being the locality given by Grube (1867) for his type-specimens. Presumably Vancauri is a printer's error for Nangkauri or Nancauri, an island in the Nicobar Group, where the Novara made extensive collections. This is held by Augener, for he changes Ehlers's specific name from *vancaurica* to *nancaurica*. I have adopted Augener's emendation.

Perinereis helleri, Grube.

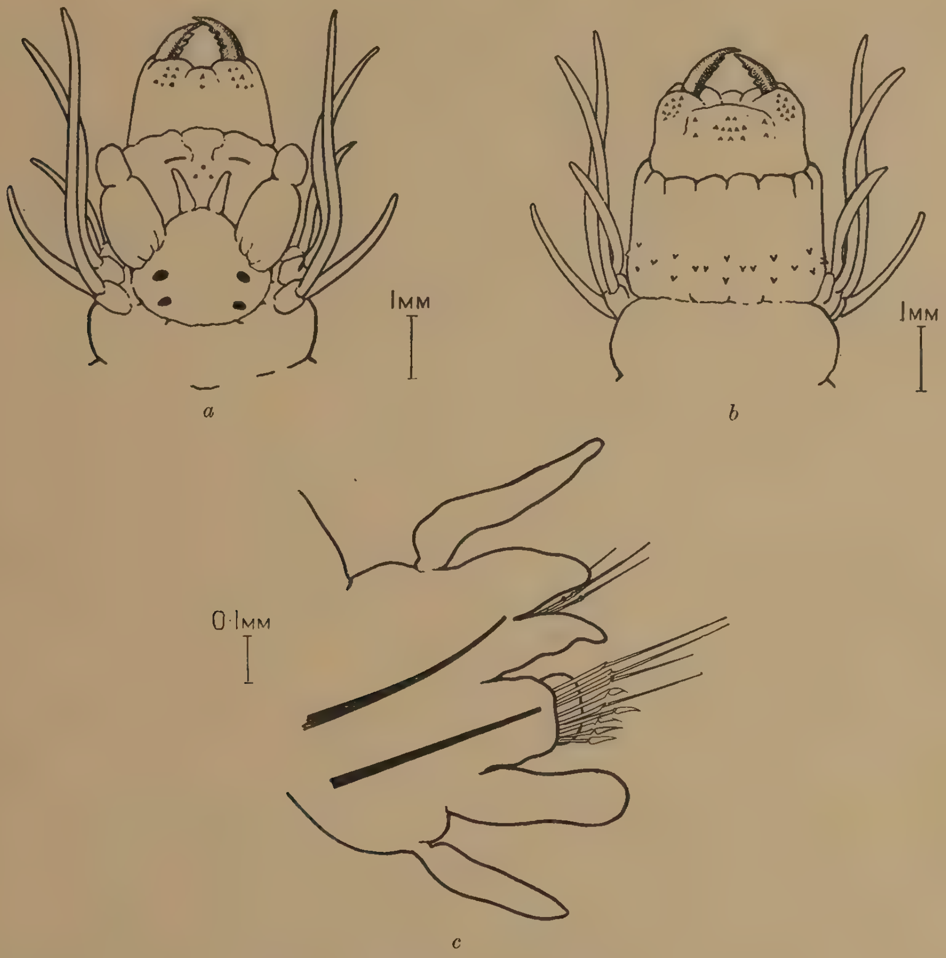
Grube, 1878, p. 81.
Horst, 1924, p. 172, pl. xxxiv, figs. 3, 4.

Occurrence.—Low Isles (2).

Remarks.—The larger specimen measures 66 mm. by 3 mm. without the feet. It has the proboscis (Text-fig. 8*a* and *b*) everted, and the arrangement of the paragnaths agrees in detail with Horst's account. Horst figures the foot.

Anteriorly the dorsal cirri (Text-fig. 8*c*) are longer than the dorsal lappet and posteriorly they are relatively longer still. The two dorsal lappets are larger relatively to the ventral ramus in the posterior region than they are in the anterior, but the upper dorsal lappet is not enlarged in the hinder region of the body in a manner comparable with that, for example, in *P. nigropunctata*. The distinctive features of this species are the separation of the paragnaths in Group III into three groups and the presence of long dorsal cirri. *P. camiguina* has a similar arrangement of paragnaths, but short dorsal cirri.

I have elsewhere (1926, p. 315) treated this species as a local variety of *P. cultrifera*, and Fauvel (1930, p. 528) regards it as a synonym of the latter species. I am now inclined to think that both *P. helleri* and *P. camiguina* are distinct species, distinguished from *P. cultrifera* by the separation of the paragnaths in Group III into three distinct groups. *P. helleri* and *P. camiguina* are set apart by the great difference in the length of the dorsal cirri.



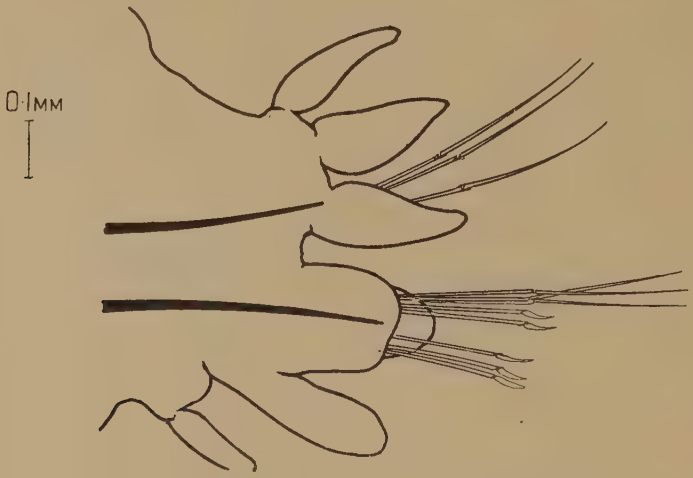
TEXT-FIG. 8.—*Perinereis helleri*. *a*, head and proboscis from above; *b*, head and proboscis from below; *c*, middle foot.

Perinereis camiguina, Grube.

Grube, 1878, p. 87, pl. iv, fig. 8.
Horst, 1924, p. 171, pl. xxxiii, fig. 7.

OCCURRENCE.—Low Isles; "From rocks" (1).

REMARKS.—A single ill-preserved specimen measuring 46 mm. by 2 mm. without the feet. The proboscis is retracted. The arrangement of the paragnaths is similar to that in *P. helleri*. The dorsal cirrus (Text-fig. 9*a*) is slightly shorter than the dorsal lappet and shows no relative increase in length in the hinder segments. There is no substantial enlargement of the upper dorsal lappet in the posterior region.



Text-fig. 9.—*Perinereis camiguina*. Middle foot.

The *P. camiguina* of Augener (1922, p. 21) is described as having the dorsal cirri longer than the dorsal lappet and should therefore perhaps be referred to *P. helleri*. The present species seems to be distinguished from *P. helleri* only by the possession of much shorter dorsal cirri.

Perinereis nigropunctata, Horst.

Horst, 1924, p. 171.

Perinereis yorkensis, Augener, 1922, p. 24, text-fig. 6 *a–e*.

Occurrence.—Low Isles; Gen. survey; 4.iv.29; F.9 (1).

Remarks.—A single specimen measuring 21 mm. by 1 mm. without the feet. It has three rows of black spots as described by Horst. The proboscis is retracted, but as far as can be seen the arrangement of the paragnaths corresponds to Augener's figures. The lappets of the feet are less massive than as figured by Augener, but the general proportions are similar, and I find a similar enlargement of the dorsal lappet in the posterior region.

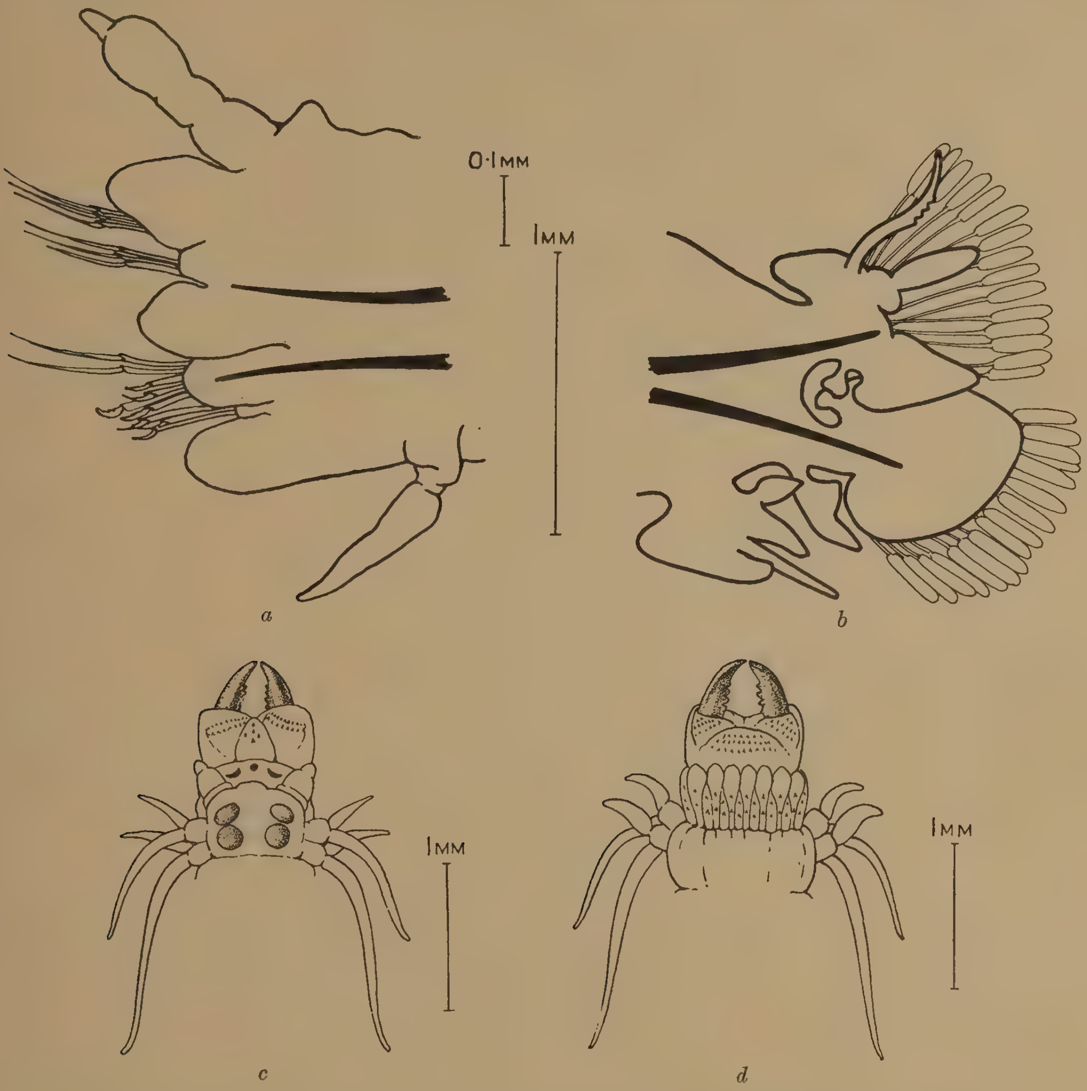
Perinereis obfuscata, Grube.

Horst, 1924, p. 173, pl. xxxiv, figs. 5, 6.

Occurrence.—Low Isles; "Worms collected round light"; 8.ix.28; 2 epitocous males and 2 epitocous females, 3.x.28; "Worms caught in lagoon after dark, phosphorescent," one epitocous female. Gen. survey; 1 atocous specimen.

Remarks.—The atocous example is an anterior fragment, in which all the colouring is lost except some brown markings on the head. The proboscis is retracted, but as far as can be seen the arrangement of the paragnaths is typical except that there are 6 paragnaths in Group I instead of the usual 5. The feet agree with Horst's figure.

The epitocous examples show interesting modifications. They measure between 12 and 15 mm. by 1 mm. without the feet. In the females the change to the epitocous condition begins at the 18th chaetiger, in the males at the 14th, in the females the thickening of the dorsal cirrus anteriorly extends over the first 5 chaetigers, in the males over the first 7 chaetigers, and in the males (Text-fig. 10*a*) it is more pronounced than in the females. Moreover, in the males only, the dorsal cirri of the sexually modified feet are crenellated on the under-surface (Text-fig. 10*b*).



Text-fig. 10.—*Perinereis obfuscata*. *a*, 5th foot of epitocous male ; *b*, modified foot of epitocous male ; *c*, head and proboscis of heteronereid from above ; *d*, head and proboscis of heteronereid from below.

One of the examples has the proboscis everted (Text-fig. 10*c* and *d*), and in this the paragnaths are arranged as follows :

I. A cruciform group of 5.
II. An oblique tristichous group of about 25.
III. A transverse group of about 25.
IV. An oblique mass of about 20.
V. One large paragnath.
VI. A single linear paragnath.
VII and VIII. A double row.

In the epitocous examples the eyes are greatly enlarged.

Fauvel (1930, p. 528) regards this species as a simple variety of *P. cultrifera.* They are indeed closely related, but that they are probably distinct is suggested by the fact that in the two species the modified heteronereid feet begin at different positions in the body. In *P. cultrifera*, in both male and female heteronereids, the epitocous feet begin from the 19th to 20th chaetigers. *P. striolata* Grube appears to differ only in the fact that the tentacular cirri reach to the 9th chaetiger, while Grube gives the 3rd chaetiger for the distance reached by the tentacular cirri of *P. obfuscata.*

In the present specimens, as in Horst's, the tentacular cirri reach to the 5th–6th chaetiger.

Platynereis polyscalma, Chamberlin.

Chamberlin, 1919, p. 219, pl. xxx, figs. 5–8 ; pl. xxxi, figs. 1–10 ; pl. xxxii, figs. 1–2.
Horst, 1924, p. 186.
Nereis (Platynereis) integer, Treadwell, 1920, p. 595, figs. 1–4.

Occurrence.—Low Isles ; " Worms collected round light, 8.ix.28 " (2).

Remarks.—Of these two specimens, one is an epitocous female measuring 23 mm. by 2 mm. without the feet and the other an epitocous male measuring 16 mm. by 1 mm. without the feet. The material does not allow me to add anything to the descriptions of this curious form by Gravier, Horst and Chamberlin.

Ceratonereis tentaculata, Kinberg.

Horst, 1924, p. 180, pl. xxxv, figs. 4–7, with synonymy.

Occurrence.—St. 12. "Magneta." 24.ii.29 ; Great Barrier Reef, Penguin Channel, 10–15½ fms., rock and shell gravel, mud on edges of pit (1).

Family Glyceridae.

Glycera gigantea, Quatrefages.

Fauvel, 1923, p. 387, fig. 152 *d–k*.

Occurrence.—Low Isles (1).

Remarks.—A single specimen without the proboscis. It is very long and slender, measuring 390 mm. by 3 mm. at its widest part without the feet. Owing to the absence of the proboscis I cannot determine this species with certainty, but the general facies, the feet with their two equal, bluntly pointed, anterior lips and the two short subequal posterior lips and the vesicular retractile gill are indistinguishable from those of the European species. Augener (1927, p. 138) records this species from New Pomerania.

Goniada tripartita, n. sp.

Occurrence.—W. of Low Isles; about 8 fms., mud; (1).

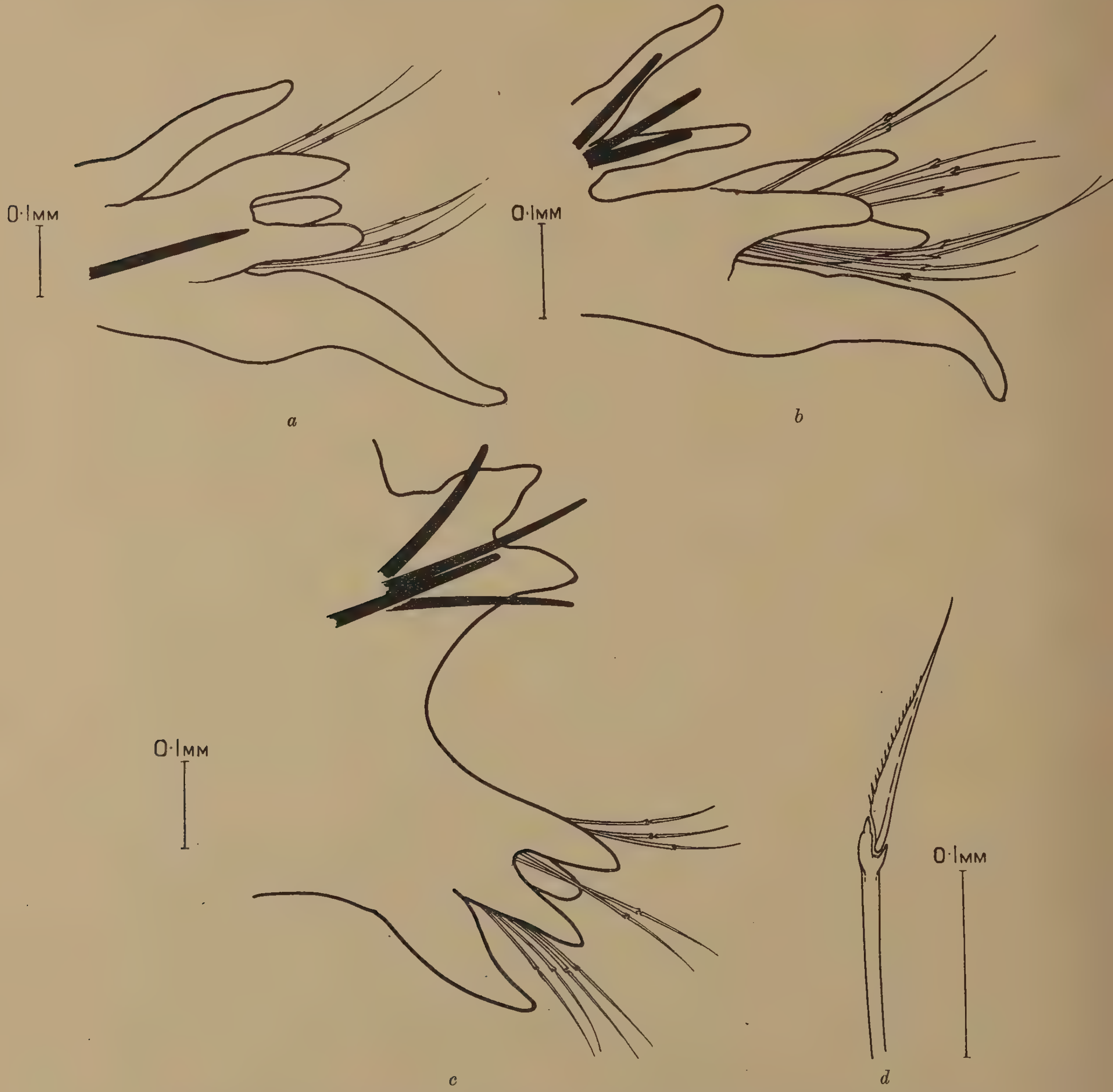
Description.—A single fragment, incomplete posteriorly and measuring 38 mm. by 2 mm. including the feet for 118 chaetigers. For the first 80 chaetigers the body is cylindrical with a pad or cushion above every foot. Behind the 80th chaetiger the body is thicker, more flattened ventrally and dorsally arched. There is a conical prostomium with 10 rings and 4 small tentacles. The long proboscis is only partly everted, and dissection shows 2 large simple jaws with 3 teeth joined by a complete circle of about 24 X-shaped paragnaths alternately larger and smaller. There are at the base of the proboscis 8 chevrons on each side.

The first 51 segments have uniramous feet; from the 52nd to the 80th the feet are biramous, but the two branches are not separated, and the final change involving the separation of the notopod from neuropod and the disappearance of the pads above the feet does not take place before the 80th chaetiger.

The first foot is much reduced. The anterior feet (Text-fig. 11*a*) consist of a dorsal cirrus, a chaetal lobe with 3 pointed lips, of which two are anterior and lie in front of the bristles and the third is shorter and lies behind the bristles, and a massive ventral cirrus. For about the first 5 chaetigers the ventral cirrus is about the same length as the prechaetal lips; it rapidly increases in size, till by about the 20th chaetiger it is almost twice as long as the prechaetal lips and as broad as the chaetal lobe. The slender dorsal cirrus reaches to the end of the short post-chaetal lip. At the 52nd chaetiger a slender cirriform notopodial prechaetal process appears just below the dorsal cirrus, and with it an aciculum and 3 acicular chaetae, arranged fanwise (Text-fig. 11*b*). In the middle portion of the body, between the 52nd and 80th chaetigers, the ventral cirrus is relatively slightly shorter and the chaetal lips slightly longer than in the anterior region. In the middle region the dorsal cirrus becomes gradually thicker and more foliaceous from before backwards, as also to a much lesser extent does the notopodial prechaetal lip.

At the 81st chaetiger, where the posterior region begins (Text-fig. 11*c*), the dorsal cirrus and notopodial prechaetal lip become two small triangular lobes of about equal size, and in addition to the notopodial aciculum there are 3 acicular notopodial bristles. The neuropod has the pedal lips rather shorter and stouter than in the more anterior regions, and the ventral cirrus is more triangular and foliaceous; it reaches as far as the ends of the prechaetal lips. The neuropod has throughout an aciculum and a fan-shaped bundle of compound bristles with an articulation similar to that in the bristles of *G. eremita*; the blades are long, delicate and finely hirsute on one edge. The ventralmost chaeta (Text-fig. 11*d*) in every foot has a much shorter and more knife-shaped blade. This condition persists throughout the body.

Remarks.—*G. tripartita* belongs to that group of species which includes *G. emerita*, Audouin and M.-Edwards, *G. australiensis*, Quatrefages, *G. antipoda*, Augener, and *G. japonica*, Izuka; these are all characterized by the presence of acicular chaetae in the notopod. The present species is distinguished by the possession of three regions of the body—an anterior uniramous region, a middle biramous region in which notopod and neuropod remain unseparated, and a third, posterior region where the change in the shape of the body and the separation of the notopod from the neuropod occur. Fauvel has



Text-fig. 11.—*Goniada tripartita.* *a*, anterior foot from in front; *b*, foot of middle region from behind; *c*, foot of posterior region from in front; *d*, ventralmost bristle of first foot.

established a subgenus *Goniadopsis* for a form with 3 regions of the body, but his species has the feet of the first two regions uniramous, and is without chevrons on the proboscis.

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Family Eunicidae.

Subfamily *Eunicinae*, Kinberg.

Eunice antennata, Savigny.

Fauvel, 1917, p. 225, with synonymy.

Occurrence.—Batt Reef (1). Low Isles (2).

St. 10. "Magneta." 22.ii.29; across Satellite Reef, working on sides to S.W. and N.E., 14–17 fms.; coral, shell gravel and mud (4).

St. 12. "Magneta." 24.ii.29; Penguin Channel, 10–15½ fms.; rock and shell gravel, mud on edges of pit (7).

St. 16. "Magneta." 9.iii.29; about ½ mile W. of N. Direction Island; 20 fms.; stony (3).

St. 17. "Magneta." 9.iii.29; about ¼ mile N. of N. Direction Island, 19 fms.; sand, thick *Halimeda* (3).

St. 19. "Magneta." 10.iii.29; about ½ mile N. of Eagle Island, 10 fms.; shell gravel, thick *Halimeda* (4).

St. 21. "Magneta." 11.iii.29; ½ mile N.W. Howick Islands, 10 fms.; mud and shell, forams (1).

St. 25. "Magneta." 17.iii.29; in Papuan Pass, 20–25 fms.; *Foraminifera* and coral fragments (2).

Eunice grubei, Gravier.

Gravier, 1900, p. 258, pl. xiv, figs. 87, 88, Text-figs. 125–129.
Pruvot, 1930, p. 68, with synonymy.

Occurrence.—Low Isles (2); Jukes Reef (1).

Eunice aphroditois (Pallas).

Fauvel, 1917, p. 215, pl. vii, with synonymy.

Occurrence.—Low Isles (1).

Eunice afra, Peters.

Fauvel, 1919, p. 374, with synonymy.

Occurrence.—Batt Reef (1); Low Isles; "Embedded in *Symphyllia*" (1).

Marphysa mossambica, Peters.

Fauvel, 1917, p. 232, fig. 22, with synonymy.

Occurrence.—Low Isles; Gen. survey; 18.iv.29; Mangrove Park (3).

Lysidice collaris, Grube.

Augener, 1913, p. 286, with synonymy.

Occurrence.—Low Isles; "From rocks" (1); Gen. survey; Boulder tract (2).

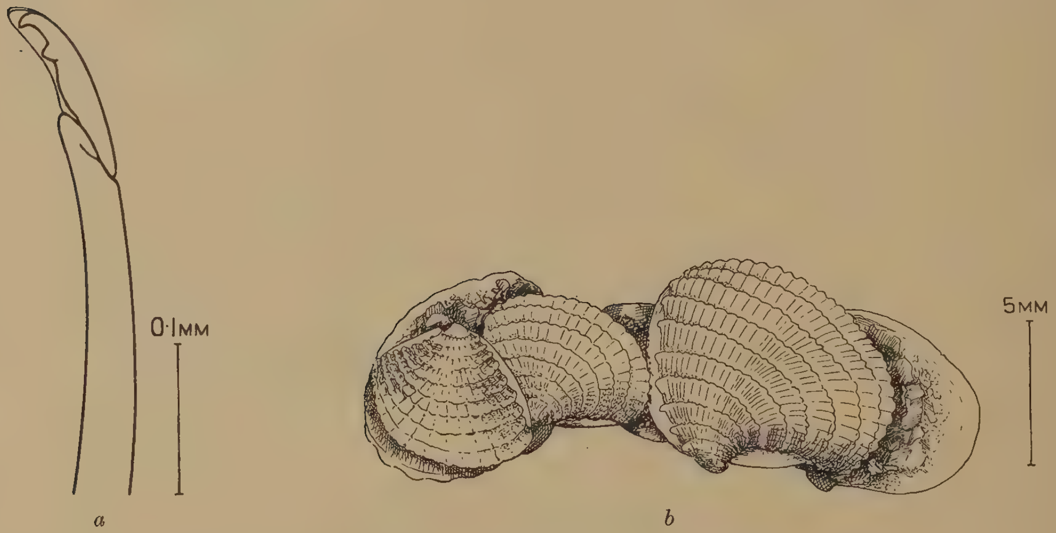
St. 10. "Magneta." 22.ii.29; across Satellite Reef, working on sides to S.W. and N.E., 14–17 fms.; bottom coral, shell gravel and mud. Dredge (1).

Subfamily *Onuphidinae.*

Onuphis, sp.

Occurrence.—Low Isles; Agassiz trawling off N. Anchorage; 9 fms.; low tide (1).

Description.—A single anterior fragment measuring 18 mm. by 2 mm. for 32 chaetigers. The head has a pair of eyes in front of the posterior lateral occipital tentacles. The ovoid palps and small frontal tentacles are of about the same length. Of the occipital tentacles the median is much the longest, reaching back to the 11th chaetiger; the anterior laterals are about a third of its length and the posterior laterals about two-thirds. The tentacular cirri reach to the bases of the palps.



Text-fig. 12.—*Onuphis*, sp. *a*, compound bristle from 1st foot; *b*, tube.

The first two chaetigers are longer than the rest and directed forwards, the ends of the first feet being on a level with the tips of the palps. They are not, however, markedly ventral in position as they appear to be in the genotype of Moore's *Paranorthia.*

The first feet consist of a slender dorsal cirrus, two rather elongated pedal lips, of which the posterior ends in a small cirriform process, and a stoutish ventral cirrus. The ventral cirrus becomes increasingly shorter and thicker from before backwards, until by the 6th foot it becomes a pad. The cirriform prolongation of the posterior lip of the foot also becomes gradually shorter, until by about the 16th foot it disappears. The gills begin as a small filament on the 9th chaetiger and remain unbranched throughout. At the 11th chaetiger the gill and the dorsal cirrus are of the same length; the gill rapidly increases in length, and the dorsal cirrus decreases so that at the 25th chaetiger the gill is about four times as long as the cirrus.

The first two chaetigers carry compound bidentate hooks (Text-fig. 12*a*); the normal bristles begin on the third chaetiger, and the 15th foot shows the usual bilimbate capillary bristles, comb bristles with the edges turned inwards as in *O. conchylega*, and a single bidentate acicular hook.

The animal was inhabiting a curious tube, consisting of a series of lamellibranch shells cemented together with their hinges at right angles to the long axis of the tube (Text-fig. 12*b*). The usual membranous cylinder forming the substructure of the tube seems to be absent.

Remarks.—I cannot attribute this example to any species with certainty. It is close both to the northern *O. conchylega* and to McIntosh's *O. macrobranchiata* from Japan. In *O. conchylega* the anterior crochets are different, and the gills do not normally begin before the 11th chaetiger.

The arrangement of the gills in *O. macrobranchiata* is the same as in the present specimen, but McIntosh figures the anterior bidentate crochets as simple. Chamberlin has described an *O. lepta* from off Panama with unbranched gills beginning on the 6th chaetiger and continued to the 53rd. He does not, however, describe the tubes of this species, which were presumably of the normal type.

Subfamily *Lumbrinereinae.*

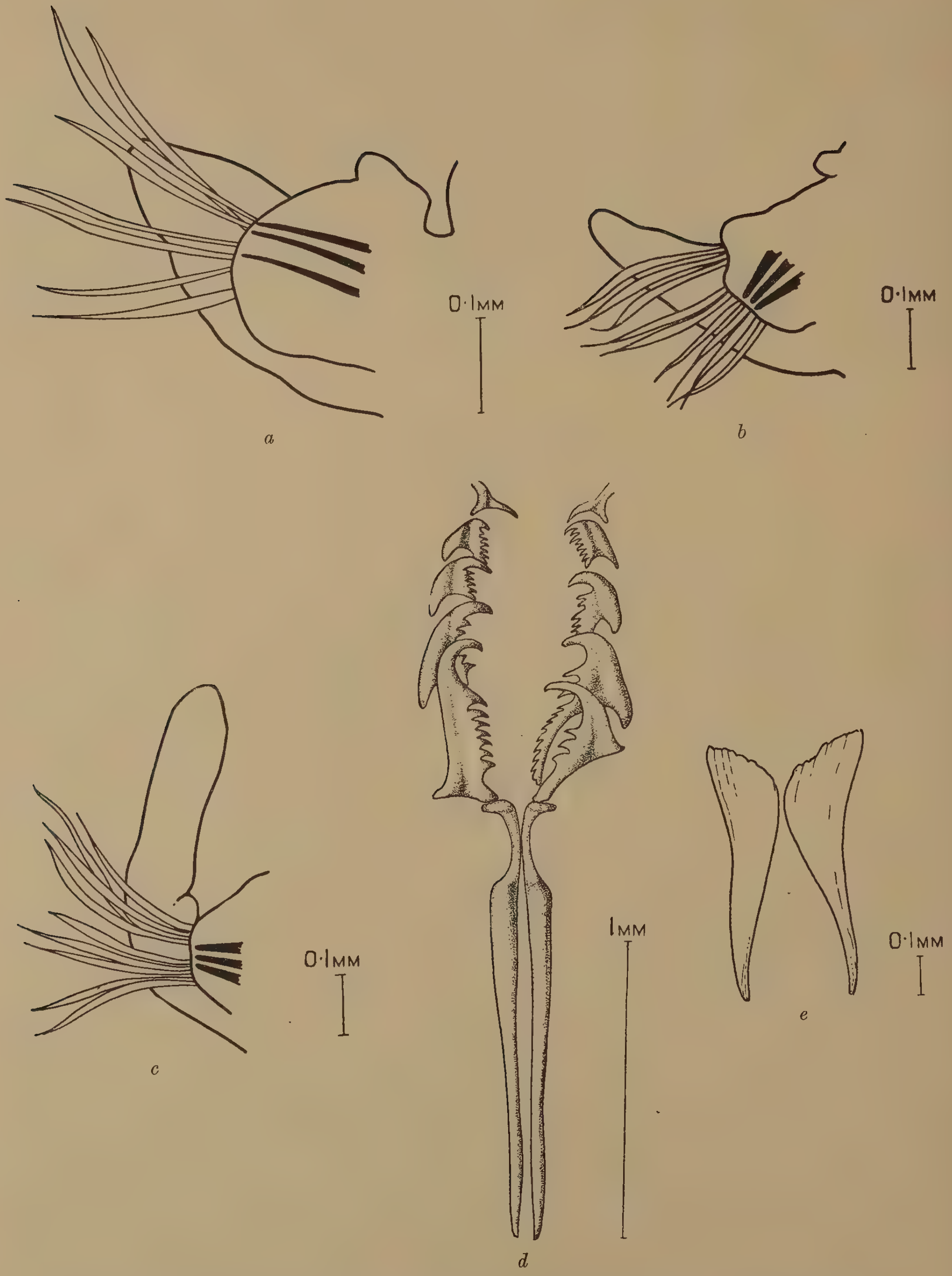
Arabella longipedata, n. sp.

Occurrence.—" Merinda." St. 2 and 3. 24.xi.28; Great Barrier Reef, Linden Bank, 28 fms.; bottom sand and shell (1).

Description.—A single example, incomplete posteriorly. It measures 72 mm. by 2 mm. for 230 chaetigers. The body is cylindrical, and somewhat flattened ventrally. There are no colour markings. The prostomium is conical and I can see no eyes. The first two segments are achaetous and about equal in length. The second segment is not involved with the mouth.

The feet are of the usual shape, with a broad rounded anterior lip and a conical cirriform posterior lip. The feet are to some extent sunken in the body-wall, and it is very difficult to discover a dorsal cirrus. In the anterior (Text-fig. 13*a*) and middle segments (Text-fig. 13*b*) there is a small rounded button at the point where the foot merges dorsally into the body-wall, and this I take to represent the dorsal cirrus. This button is indistinguishable in the posterior segments. The posterior lip of the foot shows a gradual increase in size from before backwards, and whereas in the anterior segments it is a small process shorter than the bristles, in the posterior segments (Text-fig. 13*c*) it is a large cirriform structure, directed upwards and considerably longer than the bristles. The bristles are all simple, bordered and geniculate; their appearance varies widely according to the angle at which they are seen, but I have not been able to discover the usual denticulated wing at the base of the bordering. The feet are supported by three or four tapering acicula. I have seen no dorsal bristles, and there are no hooded acicular chaetae.

The upper jaws (Text-fig. 13*d*) have a pair of long slender black carriers, behind which is a short accessory support: M.I and M.II are asymmetrical, the long M.I of the left side has the teeth continued almost up to the terminal hook; the short M.I of the right side has a rather larger diastema between the terminal hook and the teeth. The number of teeth is as follows: M.I, 8 + 4; M.II, 6 + 12; M.III, 5 + 7; M.IV, 8 + 8; M.V, 1 + 1. The lower jaws (Text-fig. 13*e*) are black and their shape is as shown in the figure.


0·1MM
a
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d
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e

TEXT-FIG. 13.—*Arabella longipedata*. *a*, anterior foot; *b*, middle foot; *c*, posterior foot; *d*, upper jaws; *e*, lower jaws.

Remarks.—I have established a new species for this specimen because I know no *Arabella* which shows a similar increase in length of the posterior lip of the foot. As far as the shape of the jaws goes, the present species is very like *A. novecrinita*, var. *asymmetrica*, Crossland (*v.* Crossland, 1924, fig. 104); but his species, equally with the *A. mutans* of Chamberlin, has hooded acicular bristles, absent from the present species. In the shape of its M.I it is intermediate between *A. iricolor* and its allies, with symmetrical pincers, and *A. geniculata*, in which the M.I have lost all resemblance to pincers and are toothed plates similar to M.II. *A. obscura* (Willey), from Ceylon (Willey, 1905, p. 285), has analogous upper jaw plates, but Willey's description was based on a small anterior fragment, and there is no reference to an increase in length posteriorly of the hinder lip of the foot. *A. moebiana* (Grube), from the Philippines, may possibly be identical with the present species, but Grube gives 4 teeth for M.V.

Family Spionidae.

Scolelepis indica, Fauvel.

Fauvel, 1928, p. 4, fig. 2, *g–m*.

Occurrence.—Low Isles; Gen. survey; 10.iv.29. The Sand Flat (1); and 20.iv.29 F.7 (2).

Remarks.—Three specimens broken into a number of fragments. I have compared them with a co-type of Fauvel's species. Fauvel (*loc. cit.*) writes that the gill begins on the 2nd chaetiger. Actually the gill begins on the 1st chaetiger. Fauvel (*in litt.*) reports that the statement that the gill begins on the 2nd chaetiger is a printer's error, which he proposes to rectify in a subsequent publication.

Family Chaetopteridae.

Mesochaetopterus minuta, Potts.

Potts, 1914, p. 963, pls. ii and iii, figs. 7, 8.

Occurrence.—Low Isles; Gen. survey; 20.iv.29. The Sand Flat, 2 specimens and a number of tubes.

Remarks.—A cluster of horny tubes incrusted with sand-grains. The tubes may have a length of 20 cm., and the diameter is about 2 mm. Nearly all are empty, but I succeeded in extracting two macerated and incomplete specimens. The largest measures 52 mm. by 2 mm. at its widest part for about 36 chaetigers. As far as their condition permits examination, they seem to resemble Potts's description and figures, and in spite of the fact that they are twice as large as any examples recorded by Potts, I believe them to belong to Potts's species. The condition of the present specimens does not permit me to add anything to Potts's account. Potts mentions the occurrence of his species in the Torres Straits.

Family Opheliidae.

Armandia lanceolata, Willey.

Willey, 1905, p. 228, pl. v, fig. 120.
Fauvel, 1919, p. 435, with synonymy.

Occurrence.—Low Isles (1).

Remarks.—A single ill-preserved specimen. The anal funnel is destroyed. There are 29 chaetigers, gills from the 2nd to the 26th chaetigers, 3 cephalic eyes, and lateral eyes from the 7th to the 17th chaetigers.

Family Capitellidae.

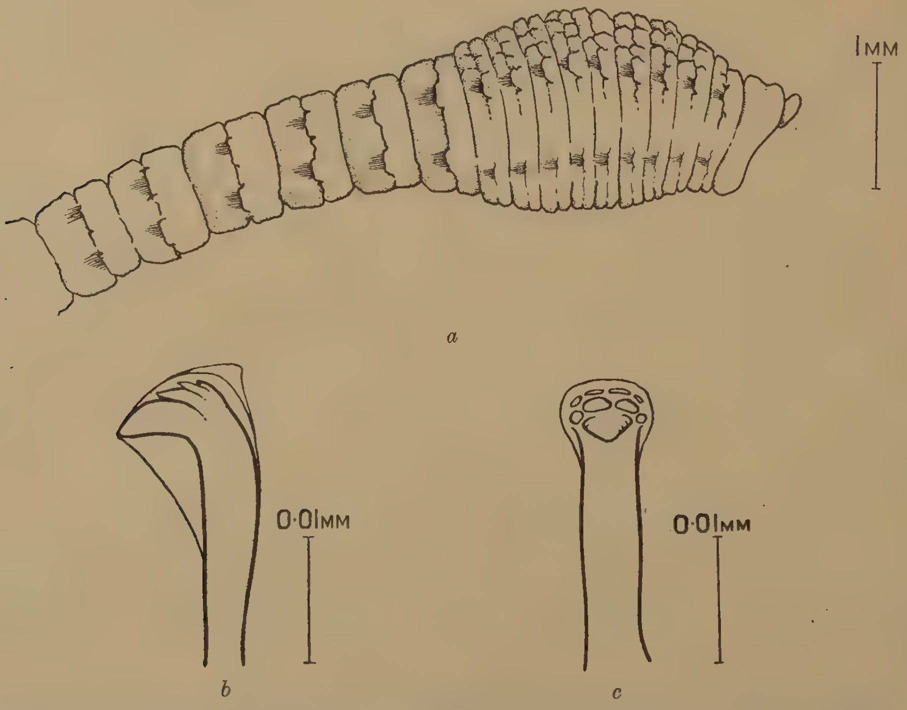
Genus *Dasybranchethus*, gen. nov.

Generic Diagnosis.—Capitellids with 16 thoracic segments, of which 15 are chaetigers. The thorax carries capillary bristles only, and the abdomen only hooks. No gills were seen.

Dasybranchethus fauveli, n. sp.

Occurrence.—Low Isles (1).

Description.—The specimen measures 90 mm. by 2 mm. at the widest part and 1 mm. at the narrowest; the length of the thorax is 6 mm. The body is cylindrical and contracted anteriorly, so that its thickest part is at about the 5th chaetiger.



Text-fig. 14.—*Dasybranchethus fauveli.* *a*, thorax seen from the side; *b*, hook in profile; *c*, hook, seen from in front.

The prostomium is tongue-shaped, and I see no eyes. It is retracted within the buccal segment so that only its tip can be seen. The buccal segment is slightly longer than the following segment, and appears to be considerably longer dorsally than it is ventrally. On the dorsal surface it is faintly divided into three incomplete rings, which disappear at the sides of the body. The remaining thoracic segments are biannulate (Text-fig. 14*a*). The first 9 chaetigers are of about the same length; the 10th and remaining thoracic chaetigers are twice as long as the preceding thoracic chaetigers. The first 9 chaetigers have a rather irregular mosaic appearance on the dorsal surface, which disappears at the sides and on the ventral surface. The transition from thorax to abdomen is not sharply marked. There are 15 thoracic chaetigers, each with a pair of dorsal and a pair of ventral bristle-bundles, coming out of shallow pits and composed of simple capillary bristles.

The abdominal chaetigers are very numerous. Unfortunately the state of preservation is not good, the integument is spongy, and neither branchiae nor the limits of the segments can be discovered. There are hooks only in the abdomen, and they have 3 rows of teeth above the main fang (Text-fig. 14*b* and *c*).

There is no copulatory apparatus and, as far as I can tell, no anal appendage. The anus appears to be terminal.

REMARKS.—The number of thoracic segments with only capillary bristles is so distinctive that in spite of the poverty of the material I felt justified in establishing a new genus for this specimen. It belongs to the group of Capitellids that are without copulatory apparatus, with only capillary bristles in the thorax and only hooks in the abdomen, and probably without gills.

Genus *Dasybranchus*, Grube.

Dasybranchus, sp.

OCCURRENCE.—Low Isles; Gen. survey; 10.iv.29; F.7 (1).

REMARKS.—This example consists of the thorax and one damaged abdominal segment of a *Dasybranchus*. It is probably a fragment of *Dasybranchus caducus*, Grube.

Family AMPHICTENIDAE.

Pectinaria (*Pectinaria*) *brevispinis*, Grube.

Grube, 1878, p. 210, pl. xi, fig. 2.
Nilsson, 1928, p. 64, fig. 20, A–G.

OCCURRENCE.—Low Isles (1); Gen. survey; Mangrove Park (1).

REMARKS.—I have little doubt that the specimen in the Berlin Museum, redescribed by Nilsson, is in fact, as he assumes, the type of Grube's species. The present examples, which have the characteristic small first pair of tentacular cirri, agree fairly closely with Nilsson's account. There are, however, a few minor differences.

In the larger and better preserved of the two examples the paleae, of which there are two groups of 13, occupy more of the large cephalic plate, and the buccal tentacles are much longer and more numerous than in Nilsson's account. Grube's type measured 90 mm. by 17 mm. over the segment bearing the paleae, the present specimen measures only 55 mm. by 14 mm.

As far as the 2nd chaetiger there are thick, fleshy, glandular folds running across the ventral surface. These are interrupted in the mid-ventral line by a cushion in the last branchiferous and the first chaetigerous segments. In the 2nd chaetiger this cushion is bilobed. Behind the 2nd chaetiger the glandular pads lie just below the feet and are widely separated. There are 9 anal hooks on each side.

Of the tubes, that belonging to the larger of the two specimens was preserved dry and has begun to crumble away. It measures about 90 mm. in length by 18 mm. in diameter at its widest part and 10 mm. at its narrow end. That belonging to the smaller of the two examples is not so large and is rather more curved. It measures 80 mm. in length by 14 mm. in diameter at its widest part and 7 mm. at its narrow end. Except that the present tubes are a little more curved, Nilsson's photograph (fig. 21*a*) of the tube of Grube's type closely resembles these from the Great Barrier Reef.

Pectinaria (*Pectinaria*) *antipoda*, Schmarda.

Nilsson, 1928, p. 69, figs. 22 and 23, with synonymy.
Pruvot, 1930, p. 78.

Occurrence.—Low Isles (1).

Remarks.—I rather doubtfully assign this example to Schmarda's species. It measures 35 mm. by 7 mm. It agrees in the main with Nilsson's account. There are 17 bristle-bearing and 13 hook-bearing segments. The posterior lateral appendages of the cephalic membrane are longer than the anterior.

The ventral glandular pad of the 2nd chaetiger is not in the present specimen divided into a series of lobes, but forms a wrinkled band across the segment, continuous except for a break in the mid-ventral line.

The scaphe resembles Nilsson's figure except that it is not so sharply constricted off from the last abdominal segment, and the length is rather greater relative to the breadth. The arrangement of the lappets and of the anal cirrus is, however, similar. The bristles and hooks agree with Nilsson's account.

The tube measures 62 mm. by 11 mm. at the wider end and 4 mm. at the narrower end. It is slightly curved and built of large sand grains, black, grey and white in colour. The surface is rougher than that of the tube of *P. brevispinis*. I see no shell fragments in its composition.

Family TEREBELLIDAE.

Loimia medusa (Savigny).

Fauvel, 1902, p. 94, text-figs. 43–45.
Hessle, 1917, p. 170, for synonymy.

Occurrence.—Low Isles (1); about 8 fms., mud, off West of Low Isles (1).

Remarks.—Of these two specimens one is large, measuring 90 mm. by about 10 mm. at its widest part for 40 chaetigers, and the other measures only 22 mm. for 65 chaetigers.

The small specimen is a more or less uniform pale brown in colour. In both the tentacles are lost. The larger specimen is pale yellow, generously mottled with black. In the anterior region there are black bands running parallel with the tori along the sides of the body and meeting in the mid-ventral line. Behind the last ventral scute these black bands become rapidly fainter and are soon indistinguishable from the general black mottling.

These specimens seem to be typical examples of the species. The exact posterior limit of the scutes is difficult to determine, but they seem to end at the 9th chaetiger. The larger specimen is accompanied by its tube, which is composed of shell fragments and pebbles.

In the present collection are three further examples of *Loimia*, which I have with hesitation treated as specifically distinct from the present specimens and attributed to *L. montagui*.

Loimia montagui (Grube).

Willey, 1905, p. 303, pl. vi, figs. 160–163, with synonymy.

Occurrence.—St. 9. "Magneta." 22.ii.29; Penguin Channel, 12–14 fms., in clean pit and on mud at sides (1).

St. 14. "Magneta." 7.iii.29; ½ mile S.E. Lizard Island, 19 fms., shell, gravel, rich *Halimeda* (1).

St. 23. "Magneta." 12.iii.29; in lee of Turtle Isles, 8 fms., mud and shell (1).

Remarks.—Of these three specimens, with an average measurement of 30 mm. by 4 mm. for 27 chaetigers, one is buff-coloured, one grey, and the third cream-coloured. In the last the black markings, so conspicuous in the other two, are so much faded as to be almost invisible. In the buff and in the grey specimens the black lateral stripes running parallel with the tori persist to about the 17th chaetiger; the continuation of these stripes across the ventral surface is only apparent for about the first six chaetigers, and is never so marked as in the larger example of *L. medusa* already described. Moreover, in every segment there is a very conspicuous black band across the back.

The teeth of the hooks are more numerous in these specimens than in *L. medusa*. In the thorax the hooks have usually six teeth, five large and one small. In the abdominal tori the number is six with a rudimentary seventh.

In two of the specimens the scutes appear to be continued to the 10th chaetiger, and in the third to the 9th. The numbering of the scutes in the Terebellids is apt to be misleading; except in unusually well-preserved specimens it is very difficult to decide exactly where they end; and the large shield behind the buccal segment, in which the scutes of several segments are usually fused, may be counted as a single scute; or when it is transversely wrinkled it may be counted as two or more scutes.

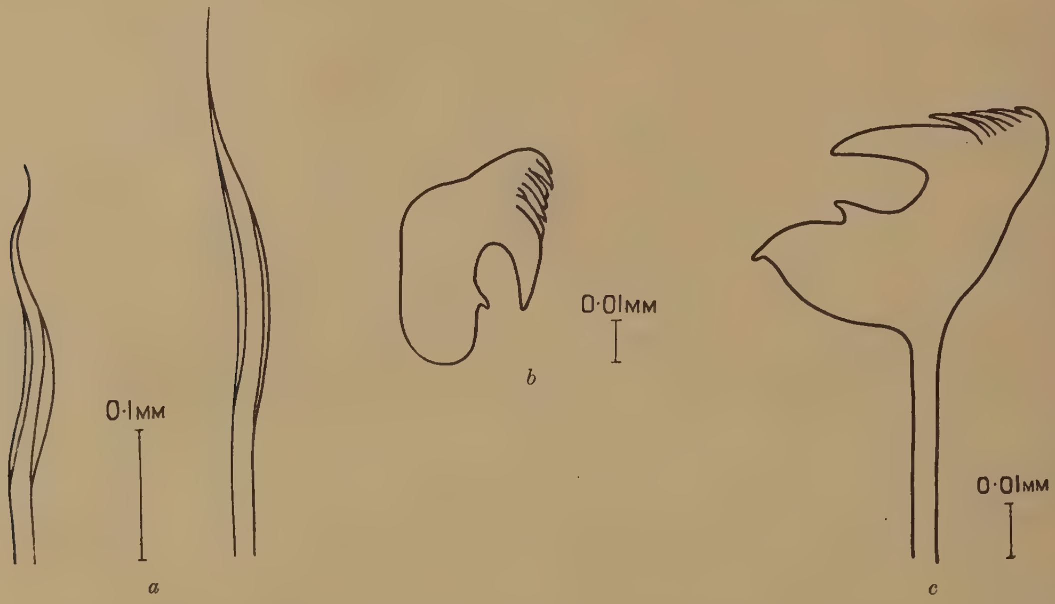
According to Willey, this species makes tubes of fine mud, very different from that of *L. medusa*. Otherwise the distinction between it and *L. medusa* is slender. *Loimia* is in need of revision, and this would necessitate an examination of Grube's type-specimens. Hessle (1917, p. 170) regards *L. annulifilis* as a synonym of *L. medusa*; Augener (1927, p. 142) treats it as a distinct species. The latter author (1926, p. 466) also thinks that *L. montagui* is probably a synonym of *L. medusa*.

Pista typha (Grube).

Terebella (*Pista*) *typha*, Grube, 1878, p. 232, pl. xii, fig. 4.
Pista typha, Hessle, 1917, p. 155.
Pista typha, Augener, 1927, p. 143.

Occurrence.—Low Isles; from gut of an Enteropneust, probably *Balanoglossus carnosus* (1).

Remarks.—The specimen has lost all its colour and measures 65 mm. by 2 mm. across the thorax. The thorax and the caudal end project from a parchmenty tube incrusted with sand grains. The example is partly digested and the details of the anterior segments cannot be studied. The tentacles are fairly numerous, but rather short and slender. The gills are mop-like, and indistinguishable from those of *P. cristata*. The left-hand member of the anterior pair is missing, and of the posterior pair the right hand member is considerably larger than both the remaining gills, the left-hand member of the posterior pair being about equal in size to the right-hand member of the anterior pair.



Text-fig. 15.—*Pista typha*. *a*, bristles; *b*, posterior thoracic hook; *c*, hook from 1st torus.

There are 17 pairs of notopodia; the bristles (Text-fig. 15*a*) are widely bordered and very like those of *P. cristata*. They end in a simple tip; some are much shorter than the rest and have a sickle-shaped appearance.

In the anterior thoracic segments the hooks are in simple rows; in the middle and posterior thoracic segments they are in single alternating rows. I could not ascertain the segment at which the change takes place. The uncini (Text-fig. 15*b*) appear to have five or six teeth and several rows of denticles above the main fang. Hessle gives eight teeth above the main fang. The hooks of the first two or three tori have a posterior prolongation (Text-fig. 15*c*). In the abdominal region the tori are transformed into projecting pinnules. There are about 15 ventral gland-shields.

I have doubtfully attributed this very imperfect specimen to Grube's species. It agrees in the main with Grube's account. Grube gives 13 ventral scutes ; in the present specimen they cannot be counted accurately, but they appear to be about 15 in number. Grube describes the dorsal bristles as " haud limbatae " ; this is probably an oversight. Hessle describes the bristles of the examples attributed by him to Grube's species as widely bordered, as they are in the present specimen. Finally I find this species difficult to separate from the widely distributed *P. cristata.*

Family SERPULIDAE.

Spirobranchus giganteus (Pallas).

Spirobranchus giganteus, Ehlers, 1887, p. 286, pl. lvii, figs. 1–7.
Spirobranchus giganteus, Pruvot, 1930, p. 88 for synonymy.
Spirobranchus semperi, Mörch, Augener, 1914, p. 148 also for synonymy.

OCCURRENCE.—Low Isles ; Gen. survey ; 21.iv.29 ; " The Thalamita flat." (1). Jukes's Reef, Outer Barrier (4).

REMARKS.—These are typical examples of this common tropical species. The specimen from the Thalamita flat is rather more massive than those from the Outer Barrier, measuring 51 mm. from tail to gill-base by 5 mm. as compared with about 30 mm. by 3 mm., the average measurement of the Outer Barrier examples. Moreover the gills of the former specimen are of an intense blue colour, whereas those of the latter specimens are blue at their bases and pale pink further forward. The colour is, however, largely dependent upon the manner of preservation.

There is considerable variation in the breadth of the wings of the opercular peduncle, and no two specimens show exactly similar opercular horns. In some there are only a pair of branching, laterally directed horns, and in others there is a third and smaller horn pointing forwards and upwards (var. *tricornis* Mörch). I have examined the type of Baird's *Cymospira brachycerca*, and can add it to the synonymy of the present species.

Salmacina dysteri (Huxley).

Fauvel, 1927, p. 377, fig. 129*e–k*.
Augener, 1914, p. 160.

OCCURRENCE.—Maer Island, Torres Strait, N.W. Reef Flat, outer edge. Numerous specimens.

REMARKS.—A cluster of tubes indistinguishable from similar clusters found in the English Channel. It is difficult to remove a specimen intact, but such fragments as I have examined show nothing to distinguish them from the European species. According to Augener, the Australian *S. australis* Haswell is a synonym of this species.

REFERENCES (Polychaeta).

AUGENER, H. 1913. Polychaeta, I. Errantia. Michaelsen, W., und Hartmeyer, R. Die Fauna Südwest-Australiens. IV, pp. 65–304, pls. ii and iii, 42 text-figs.

—— 1914. Polychaeta, II. Sedentaria. Michaelsen, W., und Hartmeyer, R. Die Fauna Südwest-Australiens. V, pp. 1–170. pl. i, 19 text-figs.

—— 1922. Australische Polychaeten des Hamburger Zoologischen Museums. Arch. Naturgesch. LXXXVIII, Abt. A, H. 7, pp. 1–37, 33 text-figs.

—— 1926. Ceylon Polychäten. Jena. Z. Naturw. LXII, N.F. 55, pp. 435–472, 10 text-figs.

—— 1927. Polychaeten von Neu-Pommern. SitzBer. Ges. naturf. Freunde. Jahrg. 1926, pp. 119–152, 1 pl.

BENHAM, W. B. 1915. Report on the Polychaeta obtained by the F.I.S. "Endeavour" on the Coasts of New South Wales, Victoria, Tasmania and South Australia, I. Commonwealth of Australia. Fisheries. Biol. Res. V, pp. 173–237, pls. xxxviii–xlv, Sydney.

CHAMBERLIN, R. V. 1919. "Albatross" Polychaeta. Mem. Mus. Comp. Zool. Harv. XLVIII, pp. 514, 80 pls.

CROSSLAND, C. 1924. Polychaeta of Tropical East Africa, etc. Proc. Zool. Soc. Lond., pp. 1–106, 126 text-figs.

EHLERS, E. 1864–1868. Die Borstenwürmer, etc., Leipzig, pp. 748, 24 pls.

—— 1887. Reports on the Results of Dredging . . . in the Gulf of Mexico and in the Caribbean Sea, in the U.S. Coast Survey Steamer "Blake." Report on the Annelids. Mem. Mus. Comp. Zool. XV, pp. 335, 60 pls.

FAUVEL, P. 1902. Annélides Polychètes de la Casamance. Bull. Soc. Linn. Caen, Normandie. (5), V, pp. 59–105, 55 text-figs.

—— 1917. Annélides Polychètes de l'Australie méridionale. Arch. Zool. exp. gén. LVI, pp. 159–278, pls. iv–vi.

—— 1919. Annélides Polychètes de Madagascar, de Djibouti et du Golfe Persique. Arch. Zool. exp. gén. LVIII, pp. 315–473, pls. xv–xvii, text-figs. 1–12.

—— 1923. Polychètes errantes. Faune de France, V, pp. 488, 181 figs.

—— 1927. Polychètes sédentaires. Faune de France, XVI, pp. 494, 152 figs.

—— 1928. Annélides Polychètes nouvelles de l'Inde. Bull. Mus. Hist. Nat. XXXIV, Paris, pp. 90–96, and 159–165, 12 text-figs.

—— 1930. Annélides Polychètes de Nouvelle-Calédonie. Arch. Zool. exp. gén., LXIX, pp. 501–562, 9 text-figs.

GRAVIER, C. 1900. Contribution à l'Étude des Annélides Polychètes de la Mer Rouge. Nouv. Arch. Mus. Hist. Nat. Paris (4), II, pp. 137–282, pls. ix–xiv.

GRUBE, E. 1867. Anneliden. Reise der österreichischen Fregatte Novara. Zool. Theil. II, pp. 46, 4 pls.

—— 1878. Annulata Semperiana. Beiträge zur kenntniss der Annelt den fauna der Philippinen. Mém. Acad. sci. St. Pétersb. (7), XXV, No. 8, ix, pp. 300, 15 pls.

HESSLE, C. 1917. Zur Kenntnis der terebellomorphen Polychaeten. Zool. Bidr. Uppsala, V, pp. 39–258, 5 pls. 66 text-figs.

HORST, R. 1917. Polychaeta errantia. I. Siboga Exped. Monograph XXIVB, pp. 1–143, pls. xi–xxix.

—— 1924. Polychaeta errantia. II. Siboga Exped. Monograph XXIVC, pp. 145–198, pls. xxx–xxxvi.

KINBERG, J. G. H. 1865. Annulata nova. Öfvers. Vetensk. Akad. Förh. Stockholm, XXII, pp. 167–179.

MONRO, C. C. A. 1926. Polychaeta of the "Alert" Expedition, 1881–82. Families Hesionidae and Nereidae. J. Linn. Soc. London (Zool.), XXXVI, pp. 311–323, 11 text-figs.

—— 1928A. Notes on Some Unnamed Polynoids in the British Museum. Ann. Mag. Nat. Hist. (10), I, pp. 311–316, 4 text-figs.

—— 1928B. On some Polychaete of the Family Polynoidae from Tahiti and the Marquesas. Ann. Mag. Nat. Hist. (10), II, pp. 467–472, 4 text-figs.

NILSSON, D. 1928. Neue und alte Amphicteniden. Göteborg. Vetensk. Samh. Handl. XXXIII (4), iv, pp. 96, 30 text-figs.

POTTS, F. A. 1910. Polychaeta of the Indian Ocean. Pt. 2. Trans. Linn. Soc. London (2), Zool. XIII, pp. 325–353, pls. xviii–xxi.

—— 1914. Polychaeta from the N.E. Pacific, Chaetopteridae. Proc. Zool. Soc. Lond., 1914, pp. 955–994, 6 pls., 13 text-figs.

PRUVOT, G. 1930. Annélides polychètes de Nouvelle-Calédonie. Arch. Zool. exp. gén. LXX (1), pp. 1–93, 3 pls.

TREADWELL, A. L. 1920. Polychaetous Annelids Collected by the U.S. Fisheries Steamer "Albatross" in the Waters adjacent to the Philippine Islands in 1907–1910. Bull. U.S. Nat. Mus., C. (1), pp. 589–602, 4 text-figs.

WILLEY, A. 1905. Report on the Polychaeta. Ceylon Pearl Oyster Fisheries, Suppl. Pt. IV, Rep. XXX, London, pp. 243–324, pls. i–viii.

OLIGOCHÆTA.

Pontodrilus bermudensis, Beddard.

v. F. E. Beddard, 'A Monograph of the Oligochaeta.' 1895, p. 469; also W. Michaelsen, "Oligochäten von verschiedenen gebieten," 'Mitt. naturh. Mus. Hamburg,' 1910, xxvii, p. 84.

OCCURRENCE.—Low Isles; Gen. survey; 5.iv.29; "IM.4 and IM.5" (2); and 6.iv.29, Earthworm Spit (7).

REMARKS.—I am indebted to my colleague, Col. J. Stephenson, F.R.S., for the determination of these specimens.

ECHIUROIDEA.

Of the two Echiuroids in the collection, one is in bad condition, and the other is an example of the curious form *Pseudobonellia*, already described from the Great Barrier Reef by Johnston and Tiegs. It has paired uteri and a male tube.

Pseudobonellia biuterina, Johnston and Tiegs.

v. T. H. Johnston and O. W. Tiegs, "*Pseudobonellia*, a New Echiuroid Genus from the Great Barrier Reef," 'Proc. Linn. Soc. New South Wales,' xliv, 1919, pp. 213–230, pls. ix–xi.

OCCURRENCE.—Low Isles (1).

? *Thalassema vegrande*, Lampert.

v. A. E. Shipley, "On a Collection of Echiuroids from the Loyalty Islands, New Britain and China Straits," 'Willey's Zool. Results,' Pt. III, 1899, p. 352.

OCCURRENCE.—Low Isles (1).

REMARKS.—The condition of this specimen renders the examination of its internal anatomy impracticable. It bears a strong external resemblance to some examples from Rotuma attributed by Shipley to this species.

SIPUNCULOIDEA.

The Sipunculoids in this collection all belong to well-established tropical species, which have been studied by a number of authors, and I have nothing to add to the existing accounts. The majority were obtained from burrows in dead coral rock. For a discussion of the boring habits of Sipunculoids see Sluiter, 'Natuurk. Tijdschrift voor Nederl. Indie,' vol. l, 1891, p. 103.

Sipunculus robustus, Keferstein.

Selenka, 1883, p. 97, pl. xii, fig. 170.

Occurrence.—Low Isles (1).

Sipunculus, sp. juv.

Occurrence.—St. 5. "Merinda." 24.xi.28. Linden Bank, 37 fms.; bottom mud (1).

Siphonosoma cumanense (Keferstein).

Spengel, 1912, p. 261.
Sipunculus cumanensis, Selenka, 1883, p. 104, pl. xii, figs. 172–173.

Occurrence.—Low Isles; Gen. survey; 10.iv.29; F.7 (2).

Aspidosiphon klunzingeri, Selenka and Bülow.

Selenka, 1883, p. 115, pl. xiii, figs. 187–189.
Shipley, 1899, p. 153.

Occurrence.—Low Isles; Gen. survey; 4.iv.29; F.6 (4).—20.iv.29. The Sand Flat (1). Low Isles (1).

Aspidosiphon cumingii, Baird.

Selenka, 1883 p. 113, pl. xiii, figs. 183–186.

Occurrence.—Low Isles; Gen. survey; 20.iv.29. The Sand Flat (1). Low Isles (1).

Aspidosiphon steenstrupii, Diesing.

Selenka, 1883, p. 116, pl. i, figs. 12–13; pl. xiii, figs. 190–192.
Sluiter, 1902, p. 18.

Occurrence.—Low Isles (2). Coral rock, Low Isles (1).

Cloeosiphon aspergillum (Quatrefages).

Selenka, 1883, p. 126, pl. ii, figs. 23, 24; pl. xiv, figs. 214–216.
Sluiter, 1902, p. 30.

Occurrence.—Low Isles; Gen. survey; 21.iii.29. Tripneustes Spit (1). Boulder Tract (3). Low Isles (18).

Physcosoma nigrescens (Keferstein).

Phymosoma nigrescens, Selenka, 1883, p. 72.
Physcosoma nigrescens, Fischer, 1927, p. 210.

Occurrence.—Low Isles; Gen. survey; 21.iii.29. Tripneustes Spit (1). 22.iii.29. R.D. and R.16 (3).—11.iv.29, between Anchorage Reefs and Tripneustes Spit (1).—20.iv.29, The Sand Flat (1). Snapper Island (1). Low Isles (16).

Physcosoma pacificum (Keferstein).

Phymosoma pacificum, Selenka, 1883, p. 63, pl. i, fig. 6; pl. vii, figs. 111, 112.

OCCURRENCE.—Low Isles (1).

Physcosoma scolops (Selenka and de Man).

Phymosoma scolops, Selenka, 1883, p. 75, pl. ii, fig. 17; pl. x, figs. 138–144.
Physcosoma scolops, Sluiter, 1902, p. 12.

OCCURRENCE.—Three Isles; 7.v.29, Beach rock (1). Low Isles, coral rock (1). Low Isles (10).

Physcosoma dentigerum (Selenka and de Man).

Phymosoma dentigerum, Selenka, 1883, p. 67, pl. i, fig. 7; pl. ix, figs. 118–123.
Physcosoma dentigerum, Sluiter, 1902, p. 11.

OCCURRENCE.—Low Isles; Gen. survey; Boulder Tract (1). Low Isles (5).

REFERENCES (Sipunculoidea).

FISCHER, W. 1927. Sipunculoidea und Echiuroidea. Michaelsen, W., und Hartmeyer, R. Die Fauna Südwest-Australiens. V, pp. 199–216, pl. ii.

SELENKA, E. 1883. "Die Sipunculiden. Eine Systematische Monographie." C. Semper. Reisen im Archipel der Philippinen (2), IV, pp. xxxii, 131, 14 pls.

SHIPLEY, A. E. 1899. Report on the Sipunculoidea. A. Willey. Zool. Results. pt. ii, pp. 151–160, pl. xviii.

SLUITER, C. P. 1902. Die Sipunculiden und Echiuriden der Siboga-Expedition. Siboga Exped. Monogr. XXV, pp. 53, 4 pls., 3 text-figs.

SPENGEL, J. W. 1912. Einige Organisations-verhältnisse von Sipunculusarten und ihre Bedeutung für die Systematik dieser Tiere. Verh. Deuts. zool. Ges., XXII, pp. 261–272.

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INVESTIGATIONS

ENTEROPNEUSTA

BY

ETHELWYNN TREWAVAS, B.Sc.

WITH EIGHTEEN TEXT-FIGURES.

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INTRODUCTION.

THE Enteropneusta are represented in the collections of the Great Barrier Reef Expedition by adults of two species and Tornaria larvae of at least seven species.

The adults are *Ptychodera flava*, Eschscholtz, and *Balanoglossus carnosus* (Willey), both members of the family Ptychoderidae. Both have a wide Indo-Pacific distribution, and each has a closely related species in the West Indies. *Ptychodera flava* has been recorded from Sydney, New South Wales, and an identical or closely related species is known from the Abrolhos Islands, off Western Australia ; but this is the first record of *Balanoglossus carnosus* from the Australian coast.

None of the Tornariae can be matched with its adult, and the elucidation of the life-histories of the Pacific Enteropneusta is a much-needed piece of work. Four species are here described as new ; one of these is represented by fifty-nine specimens, but none of the others is described from more than five individuals.

Here I gladly express my gratitude to Miss A. B. Hastings, B.A., Ph.D., and to Capt. A. K. Totton, M.C., who separated some of these larvae from the plankton samples for me, while searching for members of other groups.

I am indebted to the Zoological Museum of the University of Cambridge for the loan of " cotypes " (? syntypes) of *Ptychodera asymmetrica*, Punnett, *Pt. viridis*, Punnett, and of the varieties of *Pt. flava* described by Punnett from the Maldives and Laccadives (except var. *muscula*). In addition, I have had for comparison syntypes of *Balanoglossus carnosus* (Willey), specimens of *Ptychodera flava*, collected and described by Willey, from New Caledonia, and a specimen of *Pt. bahamensis*, Spengel. These are in the collection of the British Museum (Natural History).

PTYCHODERA FLAVA, ESCHSCHOLTZ.

Ptychodera flava, Eschscholtz,[*] 1825, p. 740, pl. v, fig. 8. Spengel, 1893, p. 190, fig. P. Hill, 1897, p. 205. Willey, 1897, p. 165, pl. v ; 1899, p. 227, pls. xxvi, xxviii, figs. 1*a*, 2–11, pl. xxix, figs. 12–15, pl. xxxii, figs. 66–68. Punnett, 1903, p. 644, pls. xxxvii–xl, xlii–xlvi. Spengel, 1903, p. 271, pls. xxiv–xxix ; 1904*a*, p. 1, pl. i. Van der Horst, 1930, p. 195, figs. 62–64.

? *Balanoglossus tricollaris*, Schmarda, 1871–2, p. 273,[†] fig. (2nd edit. 1877, p. 368, fig. 237) ; = *Ptychodera ceylonica*, Spengel, 1893, p. 359, and chart ; = *Ptychodera tricollaris*, Spengel, 1904*c*.

? *Ptychodera erythraea*, Spengel, 1893, p. 173, pl. x, figs. 1–20; 1904 *b*. Klunzinger, 1902. Gravier, 1905.

? *Ptychodera viridis*, Punnett, 1903, p. 656, pl. xxxvii, figs. 2, 6, 7 ; pl. xxxix, fig. 32 ; pl. xlii, figs. 17, 19.

Eighteen specimens, of which nine, complete and apparently unregenerated, measure 27 to 50 mm. in total length ; from the Sand Flat, Low Isles, taken 20th April, 1929. Also three specimens 60 to 65 mm. long, from Low Isles, taken in August or September, 1928.

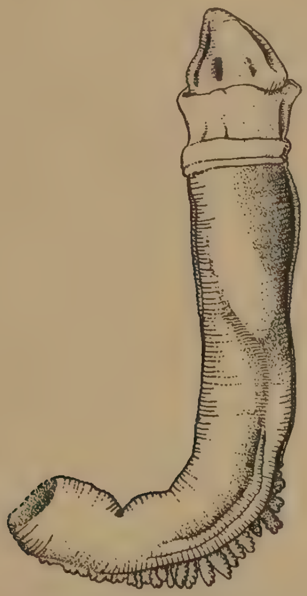
As the species is very variable it has been thought worth while to give some description of the Low Isles material. The three August–September specimens are much more slender than the others, and have smaller proboscis and collar ; although the branchial region is at least as long as in the others, the branchial basket is straight or only slightly sinuous in its course. They are evidently younger than the April animals—perhaps as much younger as the time between September, 1928, and April, 1929. Difference in method of preservation may further account for the difference in appearance. The following description applies to the April specimens only, but the measurements of the younger ones are included in the table.

---

[*] The type was incompletely described, and is not known to be now in existence.

[†] I am indebted for this reference to Spengel (1904*c*, p. 53). I have seen the second edition only.

External features (Text-fig. 1).—Proboscis usually conical, with fine transverse furrows and coarse longitudinal creases. Collar about equal in length to proboscis, with well-marked zones. "Racemose organ" well developed, simple and heart-shaped in young specimens, with three or four lobes in older. Length of collar 9 to $14\frac{1}{3}$ in total length, $\frac{3}{4}$ to $1\frac{1}{4}$ in length of branchial region. Origin of genital pleurae ventral in branchial region, rapidly becoming dorso-lateral behind it; pleurae continued in hepatic region as a pair of ridges between dorsal and lateral saccules. Gill-openings long, narrow, curved slits; branchial portion of pharynx an almost complete cylinder, communicating with the ventral portion by a narrow space between the parabranchial ridges, and exceeding it in girth. Branchial region separated from intestinal region by a short œsophageal tract to which the dorsal outline descends suddenly, rising as suddenly to about the same level behind it (*cf.* Text-fig. 2, A to D). External hepatic saccules visible 2 to $7\frac{1}{2}$ mm. behind pharynx, extending for 6 to 12 mm.; saccules large, prominent, digitiform, mostly with well-developed anterior and posterior lobules; six to ten anterior saccules dark in colour; usually all but the smaller, anterior and posterior, saccules crowded into two ranks on each side.



TEXT-FIG. 1.—*Ptychodera flava.* Incomplete specimen measuring 33 mm., seen from the left side. The hepatic saccules are more numerous than appears, for in the region of the large caeca every alternate one is crowded towards the middle line and is invisible in side view.

The surface of the body is divided into annulations which are, as usual, somewhat irregular. These are much finer than in other specimens which I have examined (Willey's specimens from Isle of Pines; types of most of the varieties from Maldives and Laccadives). In this respect and in general appearance and size the Low Isles material comes nearest to *Pt. flava* var. *maldivensis*, Punnett (1903, p. 648, pl. xxxix, fig. 27). The width of the annular ridges, and especially of the intervening furrows, is no doubt dependent upon the degree of contraction of the specimen, and this upon the muscular development of the individual, which is probably influenced by its mode of life and must increase with age. The method of preservation must also be taken into account; the Low Isles April specimens were fixed in Bouin's fluid.

Measurements of Specimens of Ptychodera flava *from Low Isles.* (1–17, *April specimens;* 18–20, *August–September specimens.*)

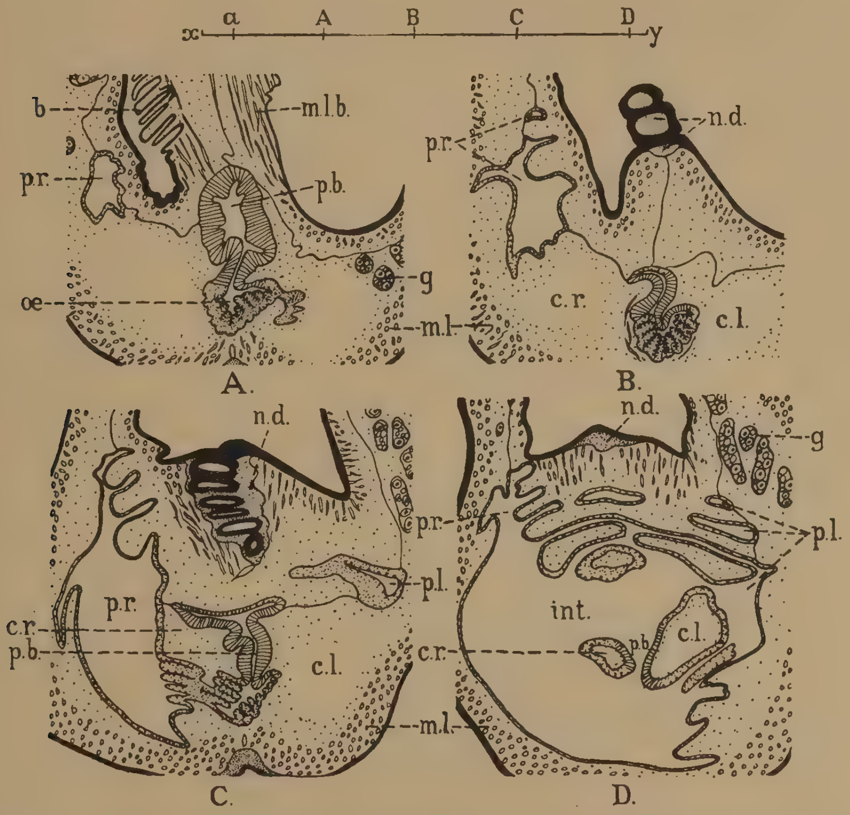
	Total length.	Proboscis length. (mm.)	Length of collar. (mm.)	Width of collar. (mm.)	Length of branchial region. (mm.)	Branchial to hepatic region. (mm.)	Hepatic region.* (mm.)	Post-hepatic region. (mm.)	Collar-length (times in total length).	Collar-length (times in branchial length).	Notes.
1	50	4½	4	5	5	5	9	25	13	1·25	..
2	50	3½	3½	5	3	7	10	24	14·3	0·9	..
3	48	4	3½	5	4	6½	9	24	13·7	1·1	..
4	39	3	3	4½	2½	4	8½	17	13	0·8	..
5	34	3	3	4½	3	3	11	13	12·3	1	..
6	28	3½	2½	3½	2½	2	6½	13	11·2	1	..
7	27	2¾	3	4	2¼	2¾	6	13	9	0·75	..
8	21	3¾	2½	4½	2½	..	..	..	8·4	1	Anal region probably regenerated.
9	..	4	3½	5½	4	8	10	20	..	1·1	Incomplete.
10	..	4½	4	5½	6	7½	12	..	..	1·5	"
11	..	4	3½	4½	2½	3½	9	..	..	0·7	"
12	..	2½	3	4	3	3½	8	..	..	1	"
13	..	4	3	4	2½	3	6½	..	..	0·8	"
14	25	3½	3½	4½	5	5	1½	7½	..	1·4	Hepatic region and anus probably regenerated.
15	..	2½	2⅓	3½	2	2½	6	..	..	0·8	Incomplete.
16	..	4	3¼	4½	3	..	..	..	..	0·9	"
17	47	2	2	3½	1	3½	10	30	..	..	Anterior end probably regenerated.
18	65	3	3	3½	4	6	10	39	21·6	1·3	..
19	60	3	3	3½	3	5	13	33	20	1	..
20	..	2	3	3⅓	6	6	7	..	..	2	Incomplete.

* External saccules.

Internal structure.—A single specimen, a male, 36 mm. long, was sectioned. Part of it was stained in picro-indigo-carmine and part in haematoxylin.

The *proboscis-musculature* is well developed, divided into groups by radial septa; circular connective-tissue fibres form a definite outline round the small anterior part of the proboscis-cavity. The left dorsal pouch of the proboscis-coelom is in open communication with the exterior by the *left proboscis-pore,* but the end-vesicle of the *right pore* does not communicate with the right dorsal pouch.

The *stomochord* gives off a pair of large lateral pouches without the mediation of a ventral caecum. The pouches have spacious cavities, which communicate by narrow channels near their posterior ends with the central cavity; the anterior end of the right pouch, still including a cavity, projects forward beyond the union of its wall with the central part of the organ. Anteriorly to this the ventral wall of the stomochord becomes thickened into an asymmetrical keel, into which the cavity presently descends, and which forms the anterior end of the stomochord. In this specimen, therefore, in so far as a ventral outpushing of the stomochord can be spoken of, it is anterior to the lateral pouches, and the stomochord here attains a greater dorso-ventral thickness than between the pouches, where the depth is about one-fifth the length of the stomochord. This is the relative depth given by Spengel for *Pt. flava caledoniensis* (1903), p. 283, pl. xxiv, fig. 3), which he contrasts with *Pt. flava laysanica* (*loc. cit.*, pl. xxiv, fig. 4), where the ratio is $\frac{1}{6}$ to $\frac{1}{7}$. The shape of the organ in his two specimens is, however, entirely different, and is much longer as well as slimmer in *Pt. flava laysanica* than in *Pt. flava caledoniensis*. All these differences are probably within the range of individual variation, which is very considerable in the allied *Pt. bahamensis* (Van der Horst, 1924, p. 51).



TEXT-FIG. 2.—A, B, C, D. Transverse sections through the post-branchial region of *Ptychodera flava*, to show the relations of the lateral intestinal pouches (× 24). The line x–y represents 1 mm. (on a larger scale than the figures), and the points A, B, C, D along it the positions of the corresponding sections relative to each other and to a, the anterior end of the right pouch. *b*, dorsal ends of posterior branchial bars; *c.l.*, coelom of left, and *c.r.* of right side; *g.*, gonad; *m.l.*, longitudinal muscles; *m.l.b.*, dorsal longitudinal muscles of branchial region; *n.d.*, dorsal nerve; *oe.*, oesophagus; *p.b.*, post-branchial canal; *p.l.*, left intestinal pouch; *p.r.*, right intestinal pouch. The thin nervous layer beneath the epidermis is omitted between dorsal and ventral nerves.

The *collar nerve-cord* has a continuous lumen, which is prolonged into the base of the single *dorsal root*. The distal part of the root is solid and is fused with the epidermis, which is invaginated to meet it ; about halfway along the root is a transverse layer of yellowish pigment-granules. At the level of the root the nervous and epithelial layers of the floor of the neural cavity are thickened in the middle ; in front of this the floor is invaginated, making the nerve-cord kidney-shaped in section ; behind, it is roughly triangular. The perihaemal cavities contain much muscle, and embrace the ventral and lateral sides of the nerve-cord.

The " body " of the *skeleton* sends forward a pair of wings, which embrace the sides of the pouches of the stomochord. The " keel " is broad and excavated in front, narrow behind.

The *collar-pores* are typical in shape, and are associated with no thickening of the basement membrane such as is described in *Pt. bahamensis* (Van der Horst, 1924, p. 53.)

Sections of the branchial region are complicated by the sinuous course of the branchial basket. The ventral, non-perforated part of the pharynx is flattened, and its walls are thrown into folds, mainly as a result of contraction of the body-wall.

The *post-branchial region* differs somewhat from the description by Van der Horst (1930, p. 199) for specimens from Hawaii and New South Wales, and more resembles the usual condition for Ptychoderidae. It is probably as variable as most of the other internal characters which have been seized upon from time to time as specific. The parabranchial ridges consist of high cells with the nuclei near the periphery ; in the upper part of the ridge the bases of these cells are clear and remain unstained, but in the lower part they become abruptly pink (in haematoxylin), and glandular. At the posterior end of the branchial region, as the gill-slits become shorter the parabranchial ridges rapidly increase in height by the increase of the glandular area, and present broad flat surfaces to each other. After the last gill-slit they meet above to form the roof of the gut and are continued as the " post-branchial canal." It is perhaps more accurate to say that there is no " post-branchial canal," if this is to be considered as the posterior, unperforated part of the branchial basket. This dorsal part of the post-branchial gut is really an extension of the canal between the parabranchial ridges. The intestine sends forward a large right and a smaller left lateral pouch, and these fuse with the dorsal wall of high-celled part of the gut, and with the ventro-lateral wall of the low-celled oesophageal portion, so as to enclose finger-like coelomic pouches, which project backwards into the intestine. (These are stated to be absent in his material by Van der Horst, *loc. cit.*) These are illustrated in Text-fig. 2, D (*c.r.*, *c.l.*), where the last traces of the high mucous epithelium can be seen forming their mesial walls.

The *hepatic region* is typical.

The *pygochord* is a thin, flexible sheet of tissue, for which it is difficult to imagine a skeletal function. It is probably important in preventing eversion of the posterior end of the gut.

SPECIMENS OF *PTYCHODERA FLAVA* FROM THE GALAPAGOS ISLANDS.

Seven specimens of *Ptychodera flava* in the British Museum were collected by Dr. C. Crossland on the Pacific cruise of the yacht " St. George " (Scientific Expeditionary Research Association), 1923–24. They are from the Galapagos (Stations 3, 4 and 6), and thus increase the known range of the species. Two complete specimens, 57 and

58 mm. long, are included, and also a specimen of 20 mm., which shows, from the proportions of its anterior end, and the fact that the "racemose organ" has seven lobes, that it has regenerated the posterior end. They are more slender than the April specimens from Low Isles, and their annulations are farther apart. Their proportions are shown in the following table :

Total length.	Proboscis.	Collar.	Branchial region.	Pharynx to hepatic cæca.	Hepatic region.
57 mm.	$2\frac{3}{4}$ mm.	$1\frac{2}{3}$ mm.	$5\frac{1}{2}$ mm.	$7\frac{1}{2}$ mm.	13 mm.
58* ,,	$1\frac{2}{3}$,,	1 ,,	<1 ,,	6 ,,	15 ,,
65 mm. (incomplete)	3 ,,	$2\frac{1}{2}$–3 ,,	6 ,,	4 ,,	42 ,,
35 ,, ,,	3 ,,	$2\frac{1}{3}$,,	$4\frac{1}{2}$,,	4 ,,	21 ,,
34 ,, ,,	$2\frac{2}{3}$,,	$2\frac{1}{2}$,,	4 ,,	3 ,,	19 ,,
32 ,, ,,	$1\frac{3}{4}$,,	2 ,,	$5\frac{1}{2}$,,	5 ,,	10 ,,
20† ,, ,,	$3\frac{1}{2}$,,	3–$3\frac{1}{2}$,,	6 ,,	..	..

* Anterior end regenerated. † Posterior end regenerated.

REMARKS ON THE SPECIES OF *PTYCHODERA*.

Several species of *Ptychodera* have been described, some of them very fully ; nevertheless the definition of species is a very difficult matter. Punnett (1903), working on the material from the Maldives and Laccadives, found that almost every little colony of *Pt. flava* had its peculiarities, and described no less than seven varieties, as well as two which he regarded as distinct species. Willey (1899) recognized a macrobranchiate and a microbranchiate form as extremes of a series, and found one form to predominate at one locality in New Caledonia, the other at another. Spengel (1903 and 1904) recognized a variety from Laysan, Sandwich Islands, another from Funafuti, both of which he considered distinct from the New Caledonia form. Recently Van der Horst, in material from Sydney and Hawaii, found specimens to agree with most of the previously described "varieties" of the species, and also a specimen (from Hawaii) which, although he regards it as belonging to *Pt. flava*, has all the characters of *Pt. erythraea*, Spengel, 1893, a very large Red Sea form. As far as the "varieties" are concerned, it seems best to follow Van der Horst and to regard *Pt. flava* as a very variable species, many of whose organs exhibit growth changes throughout life. It seems to attain a greater size in some localities than in others. Spengel, as well as Van der Horst, describes very large specimens from the Sandwich Islands, and *Pt. erythraea* from the Red Sea is probably, as Van der Horst suggests, also identical with *Pt. flava*. *Ptychodera viridis*, Punnett (1903, p. 656, pls. xxxvii, xxxix, XLII) was described from a few very small specimens, which, apart from juvenile characters, have nothing but their colour to separate them from *Pt. flava*.

Ptychodera asymmetrica, Punnett (*loc. cit.* p. 657, pl. xxxvii, figs. 1, *g* ; pl. xlvi, figs. 52, 56, 58), described from eight specimens, in all of which the right genital pleura is devoid of gonads, may be distinct.

Ptychodera tricollaris (Schmarda), from Ceylon, is insufficiently described, and may be identical with *Pt. flava*.

Pt. pelsarti, Dakin (1916), from the Abrolhos Islands, off Western Australia, differs from *Pt. flava* in having the branchial basket smaller than the ventral part of the pharynx with which it communicates by a wide channel between the parabranchial ridges. The suggestion that this is a juvenile character is supported by the association with it of weak musculature, a small and relatively simple "racemose organ" and a keeled skeleton. *Pt. flava* var. *saxicola*, Punnett (1903, p. 650, pl. xliv fig. 38) has a similar branchial region, and an incomplete specimen, including the posterior half of the pharynx, which I have examined, is as large or even larger than specimens of *Pt. flava* with long, curved gill-slits. It is possible that *Pt. flava* var. *saxicola* and *Pt. pelsarti* are identical, and distinct from *Pt. flava*.

Pt. bahamensis, Spengel, 1903, was originally described from a very young specimen, but Van der Horst (1924, pp. 50–55, pl. iv; pl. vi, figs. 1, 9; pl. vii, figs. 7, 10, 12, 14) has described a large series of specimens of all sizes, up to more than 112 mm. in length, and these show growth changes similar to those of *Pt. flava*. It is difficult to see in what the two species differ. A small specimen in the British Museum, received from Dr. Van der Horst, does not differ externally from specimens of *Pt. flava* of a corresponding age. Van der Horst states (1924, p. 51) that the genital pleurae decrease in width behind the branchial region more gradually in *Pt. bahamensis* than in *Pt. flava*; but there is much variation in *Pt. flava* in this respect, the extremes of which are illustrated in Willey's figures (1899, pl. xxvi, figs. 2, 3) of his macrobranchiate and microbranchiate forms. It is possible that short branchial region and rapid passage from broad to narrow pleurae may be expressions of a general stumpiness of form. The structure of the funnels of the collar-pores appears to be more complicated in *Pt. bahamensis* than in *Pt. flava*. Negative evidence in favour of the distinctness of *Pt. bahamensis* is found in the fact that, up to the present, identical Tornaria larvae of the type ascribed to *Ptychodera* have not been found in the Pacific and West Indian waters.

BALANOGLOSSUS CARNOSUS (WILLEY).

Ptychodera carnosa, Willey, 1899, p. 248, pl. xxvii, fig. 6; pl. xxviii, fig. 1*b*; pl. xxix, figs. 16–19; pl. xxx, figs. 20–23.

Balanoglossus carnosus, Punnett, 1903, p. 640, pl. xxxvii, fig. 3. Maser, 1913. Van der Horst, 1930, p. 187, figs. 56–59.

The material from Low Islands consists of eight fragments, only one of which includes the anterior end. This has the following measurements:

Length of proboscis	10 mm.	
Length of collar	15 ,,	
Posterior diameter of collar	13 ,,	
Length of branchial region	40 ,,	(incomplete)
Width of each genital pleura, about . . .	5 ,,	

The base of the proboscis is narrower than its anterior part, and is surrounded by the anterior part of the collar, which leaves only 3 mm. free ventrally and about 7 mm. dorsally.

The collar consists of the usual three raised zones separated by two furrows; the narrow posterior ridge is 1 mm. wide, the middle ridge 3 mm.; the anterior region is constricted about midway in the total length of the collar in the manner characteristic of the species.

The gill-pouches have ventral caeca and open by small, oval or rectangular pores. The branchial portion of the pharynx is smaller in girth than the ventral part, from which it is separated by a narrow channel between prominent parabranchial ridges.

The remaining fragments are parts, 35 to 120 mm. long, about 9 mm. in diameter, of the posterior intestinal region of animals of about the same size as that represented by the anterior fragment. The largest, which includes the anus, contained a portion of another Enteropneust, a tubicolous polychaet in a tube of coarse sand 45 mm. long and about 3½ mm. in diameter, a complete sand-anemone, a fly and some loose sand. The fact that most of these were in good condition suggests that the animal was making a hurried departure and swallowing every obstacle; it is possible that this heavily-laden posterior end was voluntarily discarded, as autotomy is known to occur in the species. The severed end of this fragment and of another were turned inside out and rolled back like a sleeve. Willey (1899, p. 256) states " an isolated piece, two or three inches long, of the abdominal region will always turn itself inside out," and, on the same page, " It breaks up into longer or shorter lengths upon slight provocation."

Dr. T. A. Stephenson tells me that " *Balanoglossus carnosus* was much more widespread " than *Ptychodera flava* " and was common on most sandy places; its presence could always be detected by its characteristic castings."

The species is recorded from Blanche Bay, New Britain (Willey), Minikoi and Hulule, Maldives (Punnett); Amboina and Kei Islands, E. Indies (Van der Horst), and Misaki, Japan (Van der Horst, and, *fide* Stiasny, 1928, Miyashita). This is the first record from the Australian coast.

The difficulty of recognizing good specific characters in adult Enteropneusta has been referred to in the case of *Ptychodera flava*. A similar problem surrounds *Balanoglossus carnosus*, which is one of a group of five described species, agreeing in the reduction of the proboscis, the enlargement of the collar (which supplements and largely replaces the proboscis as a burrowing organ), in the possession by the stomochord of dorso-lateral as well as ventral extensions, and by the gill-pouches of ventral caeca,* and in the abrupt ending of the genital pleurae. The other four species are *B. numeensis*, Maser, 1916, from New Caledonia, *B. biminiensis* and *B. jamaicensis* (Willey), 1899, from the West Indies, and *B. gigas*, Fr. Müller (Spengel, 1893), from Brazil. The resemblances of these five species to each other are much more remarkable than their differences, which reside in features shown by every fresh investigation to be subject to individual variation and growth changes. The differences between *B. carnosus* and *B. numeensis*, tabulated by Maser (*loc. cit.*, p. 422), are mainly dependent on the weaker development of the proboscis musculature, its skeleton and blood-supply in *B. numeensis*, the specimens of which were very much smaller than those of *B. carnosus*; it is possible that the shape of the collar and of the collar-pore are also connected with size. The length of the branchio-hepatic transition was compared in one specimen only of each species, and given as 10 mm. in *B. carnosus* (from Willey) and *nil* in *B. numeensis*. In Willey's figured specimen, now in the British Museum, it is only 2 mm. as preserved, so that individual variation is enough to account for the difference. *B. jamaicensis* was described by Willey from one poorly preserved, very large specimen, and Van der Horst (1930) considers it probably identical with *B. biminiensis*; this species resembles *B. carnosus* in all important characters, the chief differences being in size and correlated features. Of *B. gigas* less is known.

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* *Balanoglossus clavigerus* also has gill-pouches with ventral cæca.

It is possible that we have to deal here with one circumtropical species. On the other hand, the evidence, admittedly incomplete, of the *Tornaria* larvae suggests that at any rate there are distinct West Indian and Indo-Pacific species. The solution, if there be one, of the problem may be arrived at by two methods of attack: (1) the examination of a large series of adults of different sizes from each locality, and (2) the working out of the life-histories. It is possible that the only absolute specific characters are larval, or even that the same species may produce slightly different larval forms in different localities.*

TORNARIA LARVAE.

Introduction.

The plankton samples include 79 specimens of Tornaria larvae, representing at least seven species. Of these, 71 specimens, of four species, are from the weekly plankton station, 3 miles east of Low Isles; the others were taken on one day at two stations outside Trinity Opening. With the exception of one specimen of the most abundant species, taken in April, all those from the weekly station were taken from the end of December, 1928, to February, 1929. Hauls were taken at Trinity Opening in August, September, October and November, but only the October hauls yielded Tornariae, and these were isolated specimens, of different species and ages, none of which appears to be identical with either of the species from nearer Low Isles. Speculations as to a restricted breeding season are hardly warrantable from these results.

The question arises as to which, if any, of the four species taken near Low Isles are the larvae of the two species in the collection of adults. The most abundant larva (*T. cairnsiensis*) may be that of *Balanoglossus carnosus* (but see below, p. 62). Stiasny-Wijnhoff and Stiasny (1926) conclude, on grounds of geographical distribution, that the larva of *Ptychodera* is a large, tentaculate Tornaria, with the coelom far from the gut and attached to the body-wall. The absence of a larva of this type from the collection is not enough to disprove this suggestion, but too little is known of the geographical distribution of the group to allow much weight to be attached to a theory based on such evidence alone.

In studying this collection full use has been made of the treatise on Tornaria larvae by Stiasny-Wijnhoff and Stiasny (1927)—a work indispensable to a student of the group.

Terminology.

As is well known, the Tornaria larva has, as well as a circular ring of cilia, two ciliated bands, a praeoral between the mouth and the apical organ, and a postoral, which loops round the body to meet the apical organ from the dorsal side. Between them is the oral field. In early stages these bands are relatively simple, but later they become thrown into a series of loops, between which the oral field forms a system of grooves, interdigitating with a corresponding system of ridges of the praeoral and postoral fields. The intricacy of the pattern so formed and the relative constancy of its main features necessitated the terminology introduced by Spengel (1893, pp. 371–73). Subsequent authors, including Stiasny-Wijnhoff and Stiasny, have followed Spengel in applying the term " Lobus " to branches of the groove-system of the oral field, whereas it is more descriptive of the intervening ridges and their outgrowths. For this reason, and also because some of the German words used cannot be literally rendered in English, I have not adopted this terminology as it stands. I have replaced the word " Lobus " by " groove," and translated " Sattel " as " ridge." Stiasny-Wijnhoff and Stiasny (*loc. cit.*, p. 49) reserve the term " Tentakel " for long, narrow, fringe-forming outgrowths of the edge between groove and ridge, while blunter processes, whether they turn outwards, as in *T. weldoni* and *T. setoensis*, or are flat, are called " sekundäre Sättel " and their possessors accordingly " nicht tentakulaten." In *T. setoensis* and similar larvae the outgrowths may project freely for half their length or more and may overlap each other; their attached basal parts alone have short secondary grooves between them. I propose for them the term " lobate tentacles." The word " lobate " is intended in a descriptive sense, but it fits equally well into the German terminology because of the association with " lobate tentacles " of short secondary grooves (" sekundäre Lobus "). Thus the secondary loops of the ciliated bands produce three types of structures, which grade into each other :

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* Calman (1909, p. 326) says of the Stomatopoda—"the larval forms of the various species differ from each other more widely than do the adults." *Rana temporaria* and *Rana arvalis* are so similar as adults as to have been long confused, but their tadpoles are easily distinguished (Boulenger, 1910, pp. 205–6). The same is true of *R. tigrina* and *R. cancrivora* (Boulenger, in Boulenger and Annandale, 1918, p. 65). Giard (1891 and 1892) gives several examples, from Coelenterata, Echinodermata, Crustacea, Insects and Tunicates, of animals of the same species which produce two or three forms of larvae according to environment or habits, and remarks that if one of these "poecilogonic varieties," as he terms them, should be accompanied by a difference, however small, in the adult, systematists would not hesitate to make it a distinct species (1892, p. 1551).

(i) Secondary ridges, with equal secondary grooves.
(ii) Lobate tentacles, with smaller secondary grooves.
(iii) Tentacles, with secondary grooves absent or very small.

Of these the last is the most specialized, as Stiasny-Wijnhoff and Stiasny point out.

A tabulated comparison of the German terminology and that adopted here follows. It is illustrated in Text-fig. 10 of this paper and the diagram of Stiasny-Wijnhoff and Stiasny (*loc. cit.*, p. 58).

	Stiasny-Wijnhoff and Stiasny (= Spengel, with additions).	In this paper.	
Oralfeld	Mundbucht	Oral arch	Oral field.
	Lateral lobus	Inferior lateral groove	
		Superior lateral groove	
	Primärer ventraler Lobus	Ventral groove	
	Obere primärer dorsaler Lobus	Superior dorsal groove	
	Unterer dorsallobus	Inferior dorsal groove	
	Sekundärer Lobus	Secondary groove	
Praeoralfeld	Mittelstreifen des Praeoralfeldes	Praeoral mid-ventral ridge	Praeoral field.
	Primärer Sattel (ventraler)	Ventro-lateral ridge	
Postoralfeld	Primärer Sattel (dorsaler)	Dorso-lateral ridge	Postoral field.
	Mittelstreifen des Postoralfeldes	Mid-dorsal ridge	
	Lateralsattel	Lateral ridge	
	Ventralband	Ventral belt	
	Ventralsattel	Postoral ventral ridge	
	Sekundärer Sattel	Secondary ridge or Lobate tentacle.	
	Tentakel	Tentacle.	

The names of larval stages are taken from Stiasny-Wijnhoff and Stiasny (1927).

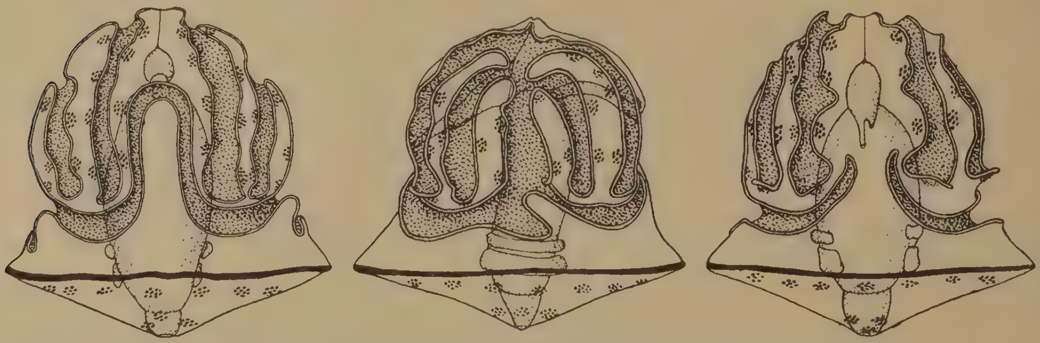
The number of tentacles or lobate tentacles appears to be a useful diagnostic character, and may be expressed in a formula. Thus, where V = ventral groove, L = superior lateral groove, D = superior dorsal groove, and the tentacles on the ventral border of each groove are enumerated before those on the dorsal border, the formula for *T. cairnsiensis* (Text-fig. 9) is V. 6–8, 6; L. 4, 4; D. 5 or 6, 5 or 6. Such a formula has the advantage over a diagram of showing the range of variation.

In naming new larval forms, the custom is followed of using "*Tornaria*" as though it were a generic name, and of deriving the specific name from that of one of its collectors, or of the locality where it was taken. A new name is given only when the Krohn-stage can be described and is clearly distinct from any other known Krohn-stage.

1. *Tornaria russelli*, sp. n. (Text-fig. 3).

Advanced Krohn-stage of a non-tentaculate larva.

Height $1\frac{1}{3}$ mm.; diameter $1\frac{1}{3}$ mm.



TEXT-FIG. 3.—*Tornaria russelli.* Holotype. Ventral, right lateral and dorsal views (× 36). Oral field, in this and subsequent figures, indicated by dark shading.

Anterior part of larva bell-shaped, with greatest diameter at ciliated ring; anal field a shallow inverted cone, the axis of which comprises $\frac{1}{5}$ of the total height. Praeoral field of a modified anchor-shape, with each lateral arm of the anchor forked to its base; anterior part of postoral field similar.

Oral arch high, with parallel limbs; upper and lower lips parallel. Inferior lateral groove triangular, with ventrally directed apex, bounded by a narrow, dorsally directed ridge on its ventral side and a scarcely perceptible eminence dorsally. Inferior dorsal groove long, with dorsal end turned upwards near middle line. Ventral, and superior dorsal grooves forked to correspond with the ridges. Praeoral and postoral ciliated bands with a wavy course, producing low secondary ridges and grooves; on each side of mid-dorsal ridge a series of four secondary ridges, of which the lowest is largest and is separated from the next by a rather deep groove. Cushions of small (? pigment-) cells present on the ridges, principally on the secondary ridges, but not on the postoral ventral ridge or the ventral belt; in addition, a ring of fifteen such cushions behind the ciliated ring and a group of nine round anus.

Proboscis-coelom ending in a right blind sac and a left dorsal pore. Paired collar- and trunk-coeloms close to gut, cylindrical, separate from each other. Oesophagus short, almost horizontal; stomach cylindrical; hind-gut small, conical.

A single specimen, from Station 19 (16° 20′ S., 146° 3′ E., outside Trinity Opening), taken 20th October, 1928, at 1 p.m., with the coarse silk tow-net (vertical haul, 180 metres of wire out).

I have associated with this species the name of F. S. Russell, Esq., D.S.C., D.F.C., B.A., who was in charge of the plankton investigations of the expedition.

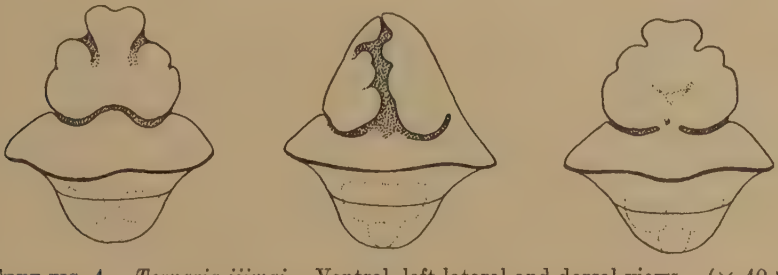
This species is distinguished from all others by the deeply forked arms of the praeoral and postoral, anchor-shaped fields. It shows affinity to the group of Tornariae associated by Stiasny-Wijnhoff and Stiasny with the genus *Glandiceps*, and including *Tornaria menoni* Stiasny, from Madras (Ramunni Menon, 1903, p. 130, pl. x, figs. 5, 6 ; also Stiasny-Wijnhoff and Stiasny, 1927, p. 118, figs. 44, 45), *T. dubia*, Spengel, from the Mediterranean (1893, p. 378, pl. xxii ; also Stiasny-Wijnhoff and Stiasny, 1927, p. 98, figs. 30–36), *T. mortenseni*, Stiasny, from Japan (1922, p. 124, figs. 1–5), and *T. ijimai*, Stiasny, from Japan (1928, p. 88, fig. 19 ; also below). *T. menoni* and *T. ijimai* have pigment-spots resembling the cushion-like groups of cells of *T. russelli* (which are colourless as preserved), but differing from them in details of distribution. The inferior lateral groove, which is invisible in a dorsal view of *T. russelli*, is situated so far ventrally in *T. menoni*, *T. dubia* and the type of *T. ijimai* that Stiasny has not identified it as a lateral groove. The forking of the ventro-lateral ridge is characteristic of the same three species, but the ridge and its divisions are very short, and there is no counterpart of the similar forked dorso-lateral ridge.

2. ? *Tornaria ijimai*, Stiasny (Text-fig. 4).

1928,* p. 88, fig. 19.

Below is a description of an opaque larva, probably of this species.

Height nearly 1 mm. ; diameter $\frac{4}{5}$ mm.



TEXT-FIG. 4.—*Tornaria ijimai*. Ventral, left lateral and dorsal views. (× 40.)

Shape a double cone. Ciliated ring much greater in diameter than any other part of larva ; axis of anal field about $\frac{2}{5}$ total height. Praeoral field divided by a pair of grooves of uncertain extent (somewhat damaged) into a mid-ventral and a pair of ventro-lateral ridges ; each ventro-lateral ridge subdivided by a narrow, shallow, secondary groove. Oral field narrow, consisting of a low oral arch, deep superior lateral grooves and long inferior dorsal grooves, approximating dorsally ; inferior lateral grooves small, triangular (preserved on one side only) ; superior dorsal groove represented by two indentations of the dorso-lateral margin of the postoral field. Ventral belt of postoral field broad, inclined at about 45° to plane of ciliated ring. A secondary circumanal ring about midway between this and anus.

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* In this paper indebtedness is acknowledged to the manuscript of Miyashita. *T. ijimai* is described by Stiasny from Miyashita's reproductions of sketches made 15th July, 1895, by Prof. Ijima.

Proboscis-pore to left of middle line; shape of proboscis coelom not visible. Paired trunk-coelom present, apparently related to gut; collar coelom ?.

A single specimen from Station 19 (16° 20′ S., 146° 3′ E., outside Trinity Opening), taken 20th October, 1928, at 1 p.m. in the 1 metre coarse silk net. (Vertical haul, 180 metres of wire out.)

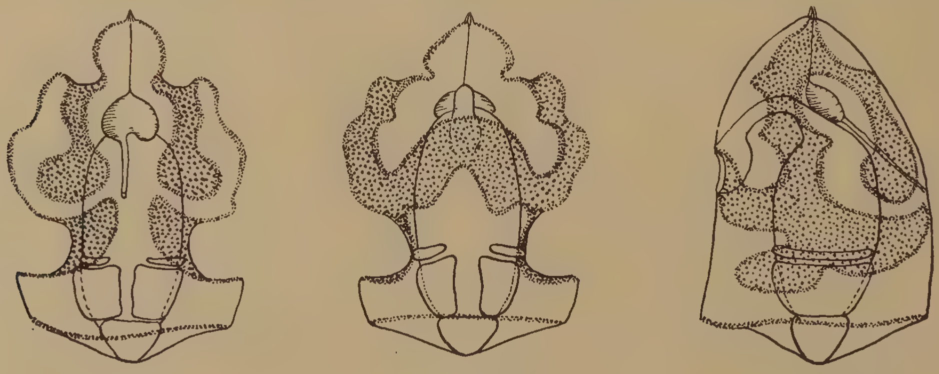
This specimen resembles *T. ijimai*, from Misaki, Japan, in the shape of prae- and post oral and anal fields, and in the low oral arch. Its opacity, the presence of a paired coelom, the narrowness of the grooves of the oral field and the greater diameter of the ciliated ring are differences indicating a more advanced stage of development. Other differences are the absence of pigment (as preserved), and the position of the inferior lateral groove; this is more ventral in *T. ijimai*, as in *T. dubia* and *T. menoni*, and gives the postoral ventral ridge a peculiar triangular shape. The condition here described may have been arrived at by the reduction of the groove-system with age, but the specimen is not well enough preserved to allow stress to be laid on this character. This Tornaria is therefore considered to be identical with or closely related to *T. ijimai*, Stiasny.

3. *Tornaria colmani*, sp. n. (Text-figs. 5, 6).

Krohn-stage of a non-tentaculate larva.

Height about $\frac{5}{6}$ mm.; diameter about $\frac{1}{2}$ mm.

Larva somewhat barrel-shaped, with shallow anal field, and with greatest diameter in region of longitudinal ciliated bands. Praeoral field five-lobed, the median lobe a little bigger than the lateral. Anterior part of postoral field anchor-shaped; mid-dorsal ridge with a pair of broad, low secondary ridges; dorso-lateral ridge with wavy outline, producing one secondary ridge on its dorsal border, two on its ventral. Oral field broad, oral arch low and wide. Postoral mid-ventral ridge triangular in older larva (Text-fig. 5), flat in younger (Text-fig. 6). Inferior lateral groove produced ventrally, bounded by a long, horizontal inferior lateral ridge on the ventral side, and a low prominence dorsally. Inferior dorsal groove broad and deep. Ventral belt of postoral field vertical or becoming narrower towards main ciliated ring. No secondary circumanal ring visible.



Dorsal. **Ventral.** **Lateral.**

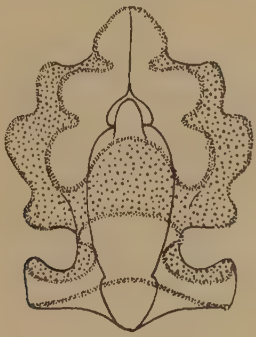
Text-fig. 5.—*Tornaria colmani*. Late Krohn stage. (× 60.)

Proboscis-coelom a heart-shaped sac, the left lobe of which is connected by a narrow duct with the single left proboscis-pore, and the apex by a slender strand with the apical organ. No paired coelom in the younger larva; a large paired trunk-coelom and a narrow collar-coelom in the older larva, close to posterior part of stomach. Mouth wide, leading by a funnel-shaped cavity into the narrow oesophagus; stomach cylindrical, long, its end projecting into the conical hind-gut.

Two specimens, syntypes of the species, representing early and late Krohn-stages, from Station 40 (3 miles East of Low Isles, 6th February, 1929), taken at 3.50 p.m. in the fine silk tow-net.

The specific name refers to J. S. Colman, Esq., B.A., member of the Expedition, who worked on the animal plankton.

This larva evidently belongs to the "*Glandiceps*-type" of Stiasny-Wijnhoff and Stiasny. It resembles *T. dubia*, Spengel, in the shape and extent of the postoral field and inferior lateral groove, in the shallowness of the anal field and the absence from it of a secondary ciliated ring, but differs from it in the shape of the praeoral field, which is more like that of *T. ijimai*. The general resemblance to *T. mortenseni*, Stiasny (1922, p. 123, figs. 1–5), is striking, but the oldest stage of this described by Stiasny is a young Krohn-stage, and its height is given as 1½ mm.; other differences are found in the shape of the stomach and of the inferior lateral groove, and in the presence in *T. mortenseni* of a secondary circumanal ring. The Barrier Reef larvae are therefore considered to represent a distinct species, related to *T. mortenseni*.



TEXT-FIG. 6.—*Tornaria colmani*. Early Krohn stage. (× 60.)

4. *Tornaria yongei*, sp. n. (Text-fig. 7).

A non-tentaculate larva in Krohn-stage.

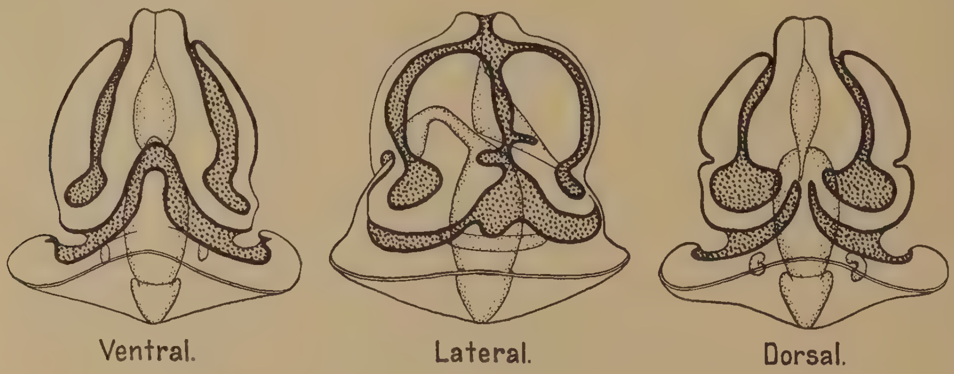
Height = diameter = 1 mm.

Anterior part of larva somewhat compressed laterally; greatest diameter at ciliated ring; postoral and anal fields meeting at a rounded edge, anal field a shallow cone. Praeoral and anterior part of postoral fields anchor-shaped. Oral arch rather low, narrow, oral field narrow, with shallow inferior lateral grooves, and long inferior dorsal grooves, nearly meeting mid-dorsally; superior lateral groove with a small secondary groove on each side, indenting the lower ends of ventro-lateral and dorso-lateral ridges; ventral groove and superior dorsal groove expanded at their lower ends. Apical organ situated in a slight depression between the raised upper ends of praeoral and postoral fields. No secondary circumanal ring visible.

Proboscis-coelom fairly large, transparent, with a single, left dorsal pore. Paired trunk-coelom present, very transparent, cylindrical, curved; situated far from gut and almost equally far from body-wall. Mouth funnel-shaped; stomach small, cylindrical, projecting into the conical hind-gut.

A single specimen, from Station 40 (3 miles East of Low Isles, 6th February, 1929), taken at 3.50 p.m. in the fine silk tow-net.

I have associated with this species the name of C. M. Yonge, Esq., D.Sc., Ph.D., leader of the Expedition.



TEXT-FIG. 7.—*Tornaria yongei.* Holotype. (× 45.)

This larva belongs to Type I of Stiasny-Wijnhoff and Stiasny, and most closely resembles *T. bournei*, Stiasny (Bourne, 1889), which, with similar larvae, is considered by Stiasny-Wijnhoff and Stiasny (1927, pp. 83, 154, 157, 187) to belong to the genus *Glossobalanus*. *T. yongei* may possibly be the larva of *Gl. ruficollis* or *Gl. hedleyi*, both of which are known from this region.

5. *Young Non-tentaculate* Tornaria *Larvae.*

Five specimens, $\frac{2}{3}$ to $\frac{3}{4}$ mm. high, $\frac{1}{2}$ mm. in diameter, are too young to be assigned to any known species or to be described as new. They represent Metschnikoff- and early Krohn-stages of a Tornaria, probably of Type I of Stiasny-Wijnhoff and Stiasny. The following is a brief description of them.

Praeoral and anterior part of postoral fields anchor-shaped. Oral arch low, wide. Grooves of oral field fairly wide; inferior lateral groove shallow, bounded by simple inferior lateral ridges; inferior dorsal groove fairly long and broad; ventral, superior lateral and superior dorsal grooves each with two secondary grooves and ridges on each side. Ciliated band thickened on the secondary ridges. Apical organ in a slight depression between raised upper ends of praeoral and postoral fields. Mid-ventral postoral ridge of medium height and width. Anal field rather shallow; no secondary circumanal ring visible.

Proboscis-coelom weakly developed, narrow, transparent, with single, left pore. No trunk- or collar-coelom present. Stomach cylindrical or pear-shaped, projecting into the conical hind-gut.

Taken in the fine silk tow-net at Station 40 (3 miles East of Low Isles, 6th February, 1929, 3.50 p.m.).

These are perhaps nearest to *T. yongei*, or may be an earlier stage of one of the larvae with lobate tentacles described below (pp. 55–62).

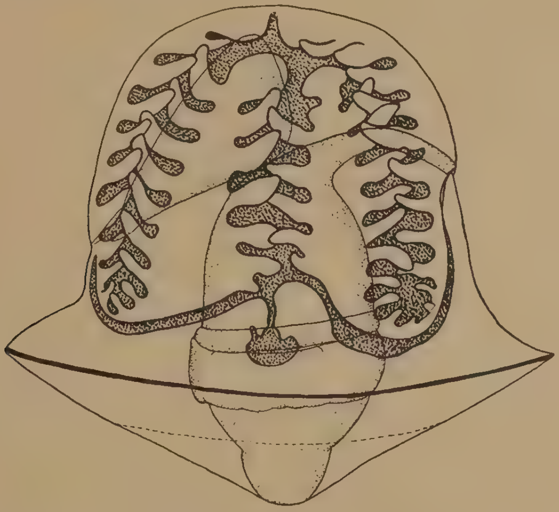
A Tornaria, $\frac{3}{4}$ mm. high, from Station 37, is very similar to these, but with the secondary ridges smaller, represented by the formula V. 2, 0 ; L. 2 or 3, 2 or 3 ; D. 0–1, 1. In the anal field is a broad ring of granular tissue like that forming the ciliated bands and their thickenings ; similar tissue surrounds the anus. This is reminiscent of the anal field of *T. russelli*, of which this may possibly be an early stage, before the forking of the primary dorso-lateral and ventro-lateral ridges has taken place.

6. *Tornaria setoensis*, Miyashita (Text-fig. 8).

Miyashita, 1925.* Stiasny, 1928, p. 73, figs. 5–7.

Below is description of an advanced Krohn-stage of a larva of this species :

Height $2\frac{1}{2}$ mm. ; diameter $2\frac{3}{4}$ mm.



Text-fig. 8.—*Tornaria setoensis*. Lateral view. (× 30.)

Upper part of body bell-shaped, with flat apical region ; anal field an inverted cone with axis less than $\frac{1}{3}$ total height. Grooves deep, with overhanging edges, narrower than the ridges. Praeoral field anchor-shaped.

Oral arch narrow, high. Inferior lateral grooves flask-shaped, with a pair of out-turned processes on the inferior lateral ridges. Inferior dorsal grooves narrow, turned upwards near mid-dorsal line, where they leave a narrow isthmus. Tentacles lobate, overlapping, free for more than half their length, the upper with ends turned upwards, not extending round upper ends of ridges ; tentacle formula, V. 11 or 12, 9 or 10 ; L. 5 or 6, 5 or 6 ; D. 8 or 9, 9 or 10. Mid-dorsal and praeoral mid-ventral ridges presenting parallel edges near apex, at which they are continuous ; apex not invaginated ; no eye-spots discerned. Ventral belt nearly horizontal. Main ciliated ring irregularly wavy (simplified in figure). Secondary circumanal ring probably present, but invisible for most of its length.

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* For the reference to this paper, which I have not seen, I am indebted to Stiasny's paper (*loc. cit.*).

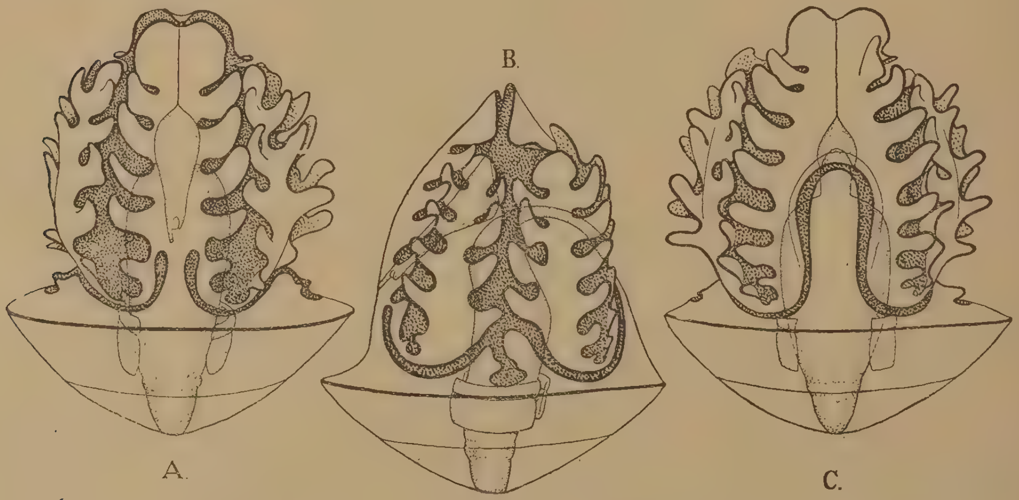
Proboscis-coelom large, with a single, left pore. Paired trunk- and collar-coeloms present, distinct but adjacent, transparent, close to gut, somewhat rounded, but not cylindrical.

A single specimen, from Station 19 (16° 20′ S., 146° 3′ E., outside Trinity Opening), taken 20th October, 1928, at 1 p.m., with the 1 metre coarse silk tow-net (vertical haul, 180 metres of wire out).

This Tornaria is considered to be specifically identical with *T. setoensis*, with which it shows a striking agreement in number of lobate tentacles,* shape of inferior lateral grooves and ridges and of the postoral ventral ridge, flatness of apical pole, etc. Certain differences suggest that this is a more advanced stage than that figured by Stiasny; the body-wall is semi-opaque; the proboscis- and collar-coeloms are larger; the diameter of the ciliated ring is relatively greater; the lobate tentacles are rather flabby, and meet or even overlap across the grooves. The slightly smaller size of the Barrier Reef specimen may be due to the shrinkage characteristic of the regressive phase of larval development.

7. *Tornaria cairnsiensis*, sp. n. (Text-figs. 9–11).

A larva with lobate tentacles.
Krohn-stage (Text-fig. 9).
Maximum height 2 mm.



Text-fig. 9.—*Tornaria cairnsiensis.* Holotype. Dorsal, right lateral and ventral views. (× 30.)

Shape a double cone; height greater than diameter of ciliated ring; axis of anal field about $\frac{1}{3}$ total height in later Krohn-stage, less in younger larvae. Praeoral field anchor-shaped.

Grooves of oral field about as wide as the ridges. Oral arch rather high and narrow. Inferior lateral grooves flask-shaped, bounded by large inferior lateral ridges, of which the ventral is usually larger; a pair of blunt processes at neck of flask. Inferior dorsal grooves long, narrow, curved upwards dorsally, with a narrow isthmus between them. Tentacles lobate, with ends turned upwards and overlapping, not continued round upper ends of ridges; V. 6–8, 6; L. 4, 4; D. 5 or 6, 5 or 6. Mid-dorsal ridge ending above in a broad lobe, which meets a similar, larger, ventral lobe, the two being reared up against each other so that the apical organ is slightly invaginated. Apical organ with a pair of eye-spots. Ventral belt of postoral field inclined at a small angle to the horizontal plane; greatest diameter of larva at ciliated ring. A secondary, transparent, circumanal ring, usually visible, mid-way between this and anus.

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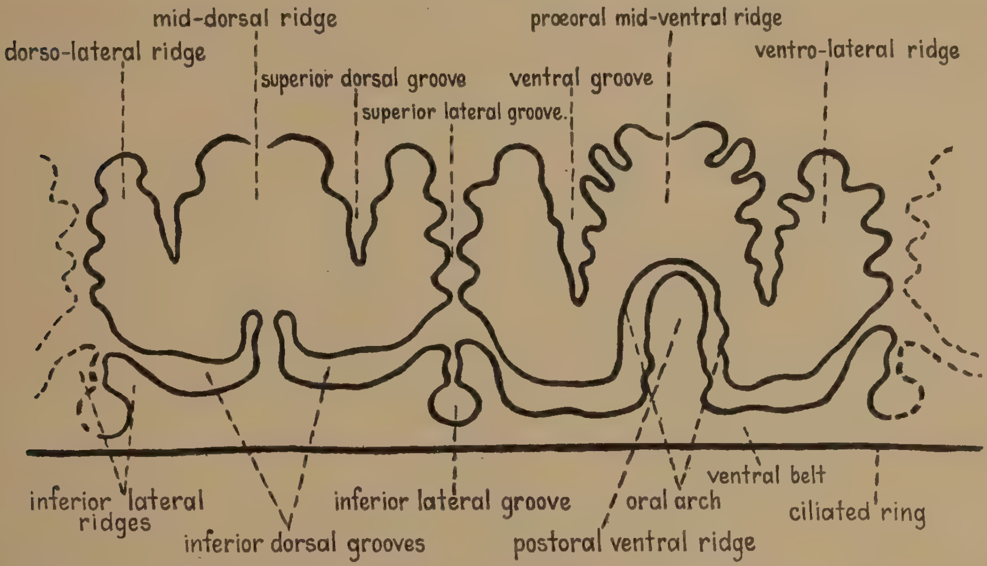
* It is difficult to understand why Stiasny, in his diagram (*loc. cit.*, p. 74, fig. 7), shows the tentacles continued round the tops of the ridges, whereas his drawings show the ridges ending, as here, in a lobe as big as two tentacles, or why the number of tentacles bordering the superior lateral groove is greater in his diagram than in his drawings.

Proboscis-coelom with a single, left pore. Paired trunk- and collar-coeloms present, close to stomach; collar-coelom narrow, attached to anterior border of trunk-coelom. Oesophagus slightly curved; stomach ovoid; with narrow end projecting into hind-gut.


mid-dorsal ridge
præoral mid-ventral ridge
dorso-lateral ridge
ventro-lateral ridge
superior dorsal groove
ventral groove
superior lateral groove.
inferior lateral ridges
inferior lateral groove
ventral belt
oral arch
ciliated ring
inferior dorsal grooves
postoral ventral ridge

Text-fig. 10.—*Tornaria cairnsiensis.* Projection of course of ciliated bands in a specimen $\frac{3}{4}$ mm. high. Secondary circumanal ring omitted.

Described from twelve specimens, $1\frac{1}{2}$ to 2 mm. high, from Stations 37 and 39, 3 miles East of Low Isles, 14th and 30th January (one in the fine, three in the coarse silk net, and two in the stramin net, St. 37; the rest in the stramin net, St. 39). These are at the height of larval development and are well preserved and transparent, forming some of the most beautiful objects of the plankton.

In addition, earlier stages are represented by:

(*a*) A single specimen (Text-fig. 11), $\frac{7}{8} \times \frac{3}{4}$ mm., taken in the coarse silk net at Station 38 (21st January, same locality).

(*b*) Four specimens, $1\frac{1}{4}$ to $1\frac{3}{8}$ mm. high, from the stramin net at Station 39.

(*c*) Thirty-eight specimens, $\frac{3}{4}$ to $1\frac{1}{2}$ mm. high, taken in the coarse silk net at Station 39.

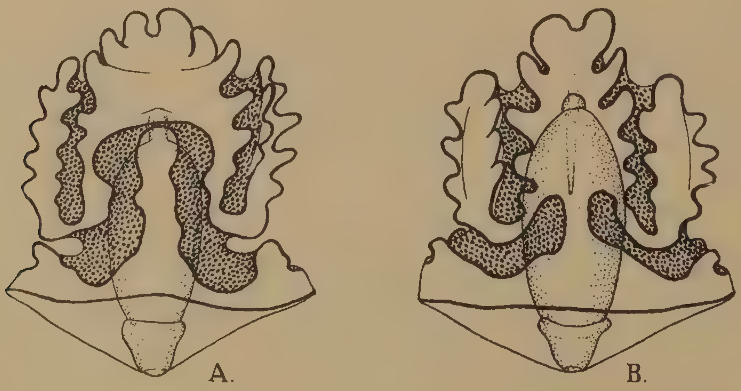
(*d*) A single specimen, 1 mm. high, taken in the coarse silk net at Station 52 (6th April, 1929, same locality).

One specimen, $1\frac{1}{4}$ mm. high, from Station 37, and two, about 1 mm. high, from Station 39, taken in the coarse silk net appear to be in an early regressive stage.

From this material five stages may be described.

(i) Height $\frac{3}{4}$ mm., diameter less than height. Transparent. First-formed parts of oral field wide; ventral and superior dorsal grooves short; "tentacles" short, few, in process of formation, those of superior lateral groove in advance of the others. Presence of secondary circumanal ring doubtful. Proboscis-coelom slender, transparent; no paired coelom. Represented by a single specimen from St. 39 (Text-fig. 10).

(ii) Height less than 1 mm.; diameter less than height. Transparent. Grooves of oral field wide; ventral and superior dorsal grooves fully formed; "tentacles" short, four on each side of superior lateral groove, those on ventral and superior dorsal grooves few, in process of development. Secondary circumanal ring present or absent. Proboscis-coelom a narrow, transparent tube, with pore. No paired coelomic sacs. Represented by the specimen from St. 38 (Text-fig. 11), and a few, less well preserved, from St. 39.



Text-fig. 11.—*Tornaria cairnsiensis.* Ventral and dorsal views of a specimen $\frac{7}{8}$ mm. high. (×60.)

(iii) Height 1 to $1\frac{1}{2}$ mm.; diameter less than height. Transparent. Grooves of oral field narrow; tentacle-formula V. 5–6, 4–5; L. 4, 4; D. 3–5, 5; inferior lateral ridge with rudiment of tentacle-like process. Secondary circumanal ring usually visible. Proboscis-coelom rounded, transparent; paired trunk-coelom and usually also collar-coelom present, small, transparent, wafer-like. Anal field conical. Several specimens from St. 37, 39 and 52.

(iv) Height $1\frac{1}{2}$ to 2 mm.; diameter less than height. Transparent. Tentacles well formed, firm; V. 6–8, 6; L. 4, 4; D. 5 or 6, 5 or 6; inferior lateral ridge with tentacle-like process. Secondary circumanal ring usually visible. Proboscis-coelom somewhat opaque and muscular; trunk and collar coeloms transparent, larger than in previous stage, but still flattened in a plane parallel to gut-wall. Anal field with sides more convex, almost a sector of a sphere; wall of anal field with tendency to be more opaque than rest of body-wall. Larval development at its climax. Represented by the eleven specimens described (Text-fig. 9).

(v) Height from a little less than 1 mm. to 1¼ mm.; diameter nearly or quite equal to height. Semi-opaque. Anterior, tentacle-bearing part of larva shrunken, somewhat depressed (but apical organ still invaginated between adpressed upper ends of praeoral and postoral fields); tentacles with tendency to become flabby; tentacle formula as stage (iv), but in one specimen apparently only three on either side of superior lateral groove. Inferior lateral ridge with out-turned process. Secondary circumanal ring visible in one specimen. Anal field shaped like a flat-rimmed bowl. Proboscis-coelom opaque; trunk- and collar-coeloms adjacent, curved cylinders, with semi-opaque walls. Early regressive ("Krohn-Spengel") stage. Represented by three specimens, none of which is sufficiently perfect or well preserved to be figured, from Stations 37 and 39 (coarse silk net).

The first two of these stages correspond most nearly to the Metschnikoff-stage of Stiasny-Wijnhoff and Stiasny, but differ from it in the presence of secondary ridges or lobate tentacles. The third and fourth are early and late Krohn-stages, but differ from the typical Krohn-stage in the early development of the collar-coelom. The fifth stage differs from a typical Spengel-stage in the retention of the lobate tentacles and relative transparency of the body-wall.

The youngest stage described here is very similar to *T. wynhoffi*, Stiasny (1928, p. 76, figs. 8 and 9), from Seto, near Osaka, Japan. The chief differences are the broader oral field and horizontal upper lip of *T. wynhoffi*; these may simply indicate an earlier stage of development, and it is possible that the two species are identical. Another possibility is that *T. wynhoffi* is a young *T. setoensis*, which must be very similar to *T. cairnsiensis* in the earlier stages. The size of *T. wynhoffi* was unknown to Stiasny.

T. cairnsiensis differs from *T. setoensis* in the shape of the apical region and number of lobate tentacles. The constant presence of four of these on either side of the superior lateral groove in specimens of 1 to 2 mm. is very striking, and it is unlikely that *T. cairnsiensis* ever attains the size of known specimens of *T. setoensis*.

Two other Tornarias which come up for comparison are *T. ritteri*, Spengel, from the Californian coast (Ritter, 1894; Ritter and Davis, 1904), and *T. weldoni*, Stiasny, from the Bahamas (Stiasny, 1921*a*; the specimen described by Morgan in 1894 does not compare so closely). These both have lobate tentacles and a convex anal field, with secondary circumanal ring. The numbers of tentacles correspond very closely, but *T. ritteri* appears to have fewer ("about three") on each side of the superior lateral groove. In the diagram of *T. weldoni* (Stiasny, 1921*a*, p. 4, fig. 1) there are four or five tentacles in this position, but the figures (pl. i, figs. 2-5) show only two or three, less well-formed than those of the dorsal groove.

T. ritteri differs from *T. cairnsiensis* in the following characters:

(i) Oral arch wider and lower.
(ii) Ventral belt apparently wider and steeper.
(iii) Dorso- and ventro-lateral ridges shorter.
(iv) Lobate tentacles shorter, not meeting across grooves.

T. weldoni differs from *T. cairnsiensis* in the following characters:

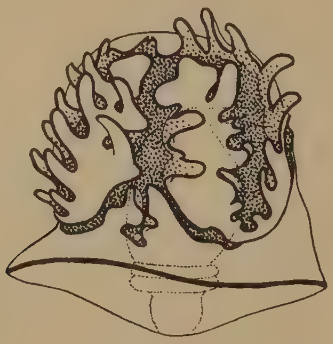
(i) Excess of diameter over height.
(ii) Absence of tentacle-like processes on inferior lateral grooves.
(iii) Collar-coelom separate from trunk-coelom.

8. *Tornaria* sp., near *T. cairnsiensis* (Text-fig. 12).

Krohn-Spengel stage of a larva with lobate tentacles.

Height 1 mm.; diameter $1\frac{1}{6}$ mm.

Upper part of body dome-shaped, with flat apical pole; axis of anal field about $\frac{1}{4}$ total height. Body-wall somewhat opaque. Oral arch high, narrow. Grooves of oral field narrow. Inferior lateral grooves flask-shaped, with prominent inferior lateral ridges, each with a blunt, tentacle-like process at neck of flask. Tentacles of a rather slender lobate type, projecting outwards; two tentacles and the rudiment of a third (indicated by " $\frac{1}{2}$ " in the formula) on superior lateral groove; tentacle formula V. 8, 6; L. $2\frac{1}{2}$, $2\frac{1}{2}$; D. 5, 6. Structure of apical organ not visible. No secondary ciliated ring detected.



TEXT-FIG. 12.—*Tornaria* sp. from Station 19. Right lateral view. (×45.)

Two pairs of cylindrical coelomic sacs close to gut, the collar-coelom adjacent to the trunk-coelom.

A single specimen from Station 19, taken in the same net as *T. setoensis*.

This Tornaria differs from the early regressive stage of *T. cairnsiensis* in the flatness of the apical pole, shallower anal field, and the presence of only two or three tentacles on either side of the superior lateral groove, although these are firm, and show no signs of degeneration. The poorness of the material of the corresponding stage of *T. cairnsiensis* makes a decision as to the specific distinctness of this specimen impossible at present.

It resembles *T. setoensis* in shape, as well as in time and place of capture, but the two are at almost the same developmental stage, and the difference in size and in number of tentacles seems too great for specific identity.

9. *Tornaria* sp. from Station 20 (Text-fig. 13).

Late Krohn-stage of a larva with lobate tentacles.

Height $1\frac{1}{4}$ mm.

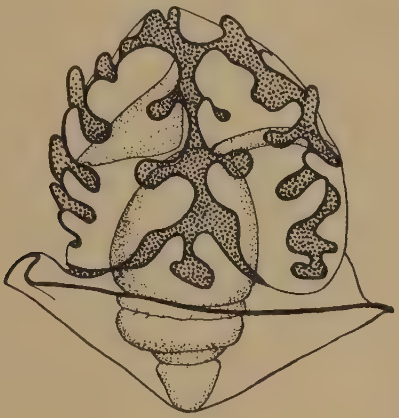
Shape a double cone. Diameter nearly equal to height: anal field convex, with axis a little less than $\frac{1}{3}$ total height. Body-wall translucent.

Inferior lateral ridges almost rectangular, without tentacle-like processes; inferior lateral groove roughly flask-shaped. Well-developed inferior dorsal grooves. Praeoral field anchor-shaped. Tentacles lobate, rather short; V. 6, 4; L. 2 or $2\frac{1}{2}$, 2; D. 4. 4, Apical organ slightly invaginated ; upper ends of prae- and postoral fields meeting at an obtuse angle. No secondary circumanal ring.

Proboscis-coelom with a single, left pore. Paried trunk-coelom present, close to gut, with adjacent collar-coelom.

A single specimen from Station 20 (16° 19′ S., 146° 7′ E., outside Trinity Opening), taken 20th October, 1928, at 11.35 a.m., in the Nansen vertical net, with 250 metres of wire out.

This Tornaria differs from specimens of *T. cairnsiensis* of the same size in the apparent absence of a secondary circumanal ring, and in having only two tentacles, or two and a small rudiment, on either side of the superior lateral groove.



TEXT-FIG. 13.—*Tornaria* sp. from Station 20. Right lateral view. (× 45.)

It differs from the small Tornaria with lobate tentacles from Station 19 (Text-fig. 12) in general shape and in having shorter, thicker tentacles, fewer on the dorsal and ventral grooves, and simpler inferior lateral ridges. It is perhaps nearest to *T. weldoni*, Stiasny, 1921*a*, in which the chief difference is the presence of a secondary circumanal ring at a corresponding stage.

10. *Regressive Stage* (*Spengel Stage*) *of a Larva with Lobate Tentacles* (Text-fig. 14).

Height $1\frac{1}{2}$ mm. ; diameter $1\frac{3}{4}$ mm.

Diameter of ciliated ring much greater than that of any other part. Upper part of larva swollen, depressed, with flattened, invaginated apical pole. Anal field shaped like a flat-rimmed bowl, its axis comprising $\frac{2}{5}$ total height of larva.

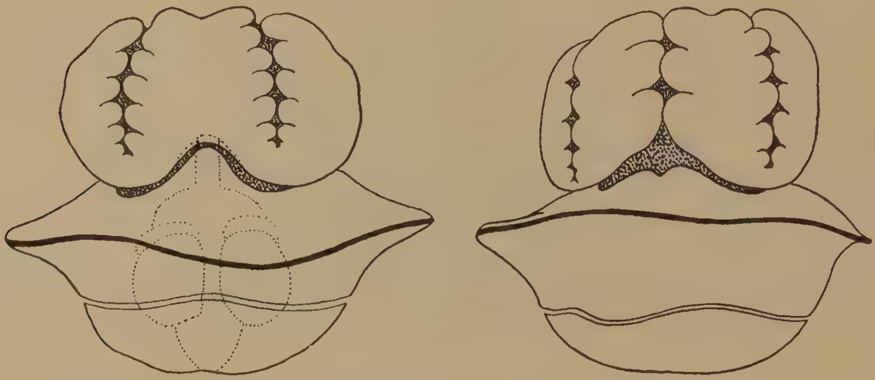
Body-wall opaque. Grooves of oral field narrow, overhung by the swollen ridges ; no praeoral and postoral ciliated bands visible. Praeoral field of anchor-shaped type. Oral arch low, enclosing a wide angle. Inferior lateral groove almost imperceptible, bounded by low eminences. Inferior dorsal groove long and deep. Tentacles represented by blunt, rounded secondary ridges, separated by narrow secondary grooves ; tentacle formula V. 6 or 7, 5 or 6 ; L. 2, 2 ; D. 4 or 5, 6. Anal field with secondary circumanal ring midway between anus and main ciliated ring.

Proboscis-coelom with a single left pore. Paired trunk-coelom close to gut, with narrow collar-coelom attached to it in front.

A single specimen from Station 19 (16° 20′ S., 146° 3′ E.), taken 20th October, 1928, at 11.42 a.m., in the Nansen vertical net (180 metres of wire out).

The body-wall is broken along the line of the secondary, circumanal ring, and only through this break could the internal organization be made out.

In number and proportions of the secondary ridges (or lobate tentacles) this most resembles the Tornaria from Station 20 (Text-fig. 13), which, however, appears to lack a secondary circumanal ring. If, as seems probable, it is a later stage of this, or some other larva with lobate tentacles, it is interesting to note that ridges, representing the "tentacles," persist when there is no longer any trace of praeoral and postoral ciliated bands, at least in surface view. In the very similar *Tornaria weldoni*, Stiasny, however, it appears that the ridges vanish by the simplification of the still visible ciliated band (*cf.* Stiasny, 1921*a*, pl. i, fig. 5).



TEXT-FIG. 14.– *Tornaria* in regressive stage. Ventral and lateral views. (× 40.)

Association of Larvae with Lobate Tentacles with Adults.

Larvae with lobate tentacles are considered by Stiasny to belong to *Balanoglossus* or *Glossobalanus*, since they are not very different from the Tornaria of *B. clavigerus*, the only Enteropneust with indirect development whose life-history has been worked out. *T. weldoni* was found where *B. biminiensis* is the common Enteropneust, and it is probable that one of the species here described belongs to the closely related *B. carnosus*. *B. carnosus* is a giant species, and this fact suggests that the largest Tornaria in question, *T. setoensis*, may belong to it. This suggestion has already been made by Stiasny (1928), in view of the association of the two in Japanese waters. Another possibility is that *T. cairnsiensis* may belong to *B. carnosus*, (see above p. 48). Speculations as to the identity of these Tornarias are, however, of little use until more is known of the Enteropneust fauna of the region, and it is very desirable that more life-histories should be worked out.

11. ? *T. delsmanni*, Stiasny-Wijnhoff and Stiasny.

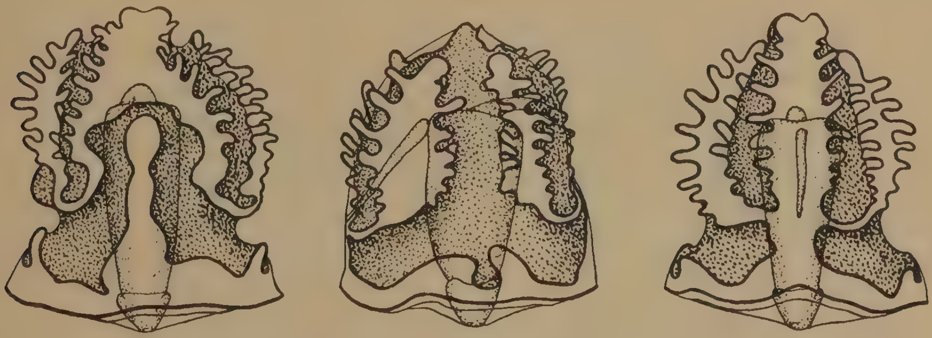
"Die Tornaria von Madoera" (*T. delsmanni*), Stiasny-Wijnhoff and Stiasny, 1927, p. 163, figs. 78, 79.

Three stages are represented in this collection, each by a single specimen:

(i) Metschnikoff-Krohn stage (Text-fig. 15). Height $1\frac{1}{4}$ mm.; diameter 1 mm.

Bell-shaped, with almost flat anal field; diameter of ciliated ring but little greater than that of anterior part of larva. Grooves of oral field broad and shallow. Praeoral field and anterior part of postoral field with very narrow bridges between their median and lateral portions.

Oral arch rather broad. Postoral mid-ventral ridge high, narrow. Inferior lateral grooves present, bounded by simple ridges, that on the ventral side the larger. Inferior dorsal groove broad, not expanded dorsally. Tentacles narrow, rather short, the lower rudimentary; V. 8 or 9, 7 or 8; L. 7 or 8, 7 or 8; D. 7, 7 or 8. Ciliated bands ending at apical organ, which is but little invaginated. Ventral belt of postoral field narrow, almost vertical. A secondary, transparent, circumanal ring close to main ciliated ring.



TEXT-FIG. 15.—? *Tornaria delsmanni*. Metschnikoff-Krohn stage (× 40.) The inner surfaces of the tentacles, although strictly part of the oral field, are left white here and in Text-figs. 16 and 17.

Proboscis-coelom a narrow strand of tissue, with a single pore near mid-dorsal line. No paired coelom. Oesophagus short, almost horizontal; stomach cylindrical, projecting into a small, conical hind-gut.

A single specimen, from Station 38 (3 miles East of Low Isles, 21st January, 1929), taken at 10.20 a.m. in the coarse silk net.

(ii) Krohn-stage (Text-fig. 16). Height nearly 3 mm.; diameter $2\frac{3}{4}$ mm.

Shape a double cone; anal field rather shallow, its axis about $\frac{1}{6}$ total height. Praeoral field and anterior part of postoral field anchor-shaped.

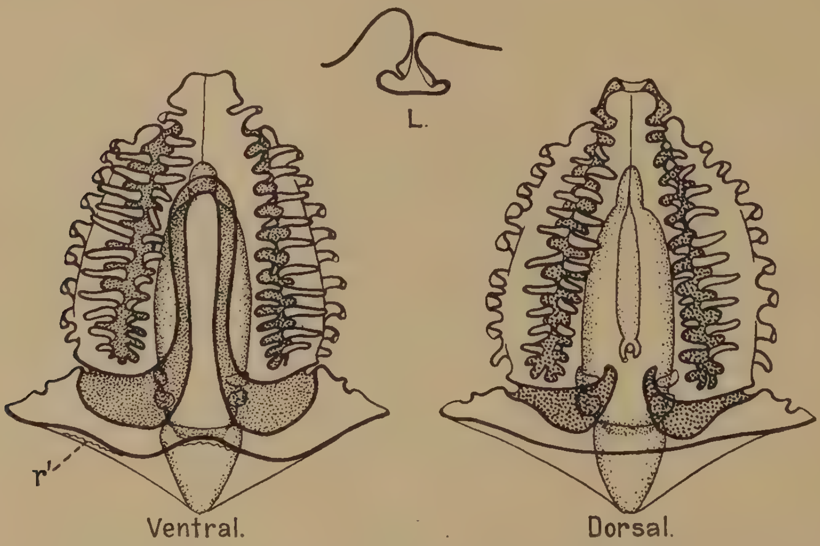
Oral arch and postoral mid-ventral ridge high, narrow. Inferior lateral grooves flask-shaped, with a short, tentacle-like process on each of the inferior lateral ridges, of which the ventral is higher than the dorsal. Inferior dorsal groove deep, somewhat expanded dorsally. Tentacles long, narrow, turned outwards and usually reflexed over ridges, continuous round lower ends of grooves, but not round upper ends of ridges. Tentacle at base of each dorsal groove longer than those next to it; V. 13–15, 10 or 11;

L. 9, 9; D. 11, 12–14. Ciliated bands ending at apical organ; upper ends of praeoral and postoral fields meeting at an acute angle, so that apex is visible from dorsal side only. A secondary circumanal ring close to main ciliated ring.

Proboscis-coelom narrow, with two short ducts, only the left of which opens by a pore. Stomach cylindrical, not wider than hind-gut, which is unusually long. Paired trunk- and collar-coeloms present, close to gut, separate from each other.

A single specimen, from Station 37 (3 miles East of Low Isles, 14th January, 1929), taken at 9.40 a.m. in the fine silk tow-net.

(iii) Spengel stage (Text-fig. 17). A fragment, consisting of the left postero-dorsal portion of the larva. This differs from the complete specimen in the greater development of the paired coelomic sacs, the broad, rather opaque proboscis-coelom, and the apparent absence of a secondary circumanal ring. The radius of the shallow anal field is about 1 mm.; the diameter was therefore probably not greater than that of the Krohn-stage. Eleven tentacles are present on one side of the most nearly complete dorsal groove. At the lower end of the superior lateral groove is an oval, cushion-like thickening of the epidermis, with a groove along its longer, dorso-ventral axis (Text-fig. 17, *ep. o.*). This is in the wrong position for a collar-pore or gill-pore, and in any case is quite unconnected with oesophagus or collar-coelom. The tissue around it is well preserved and it has the appearance of a normal structure.



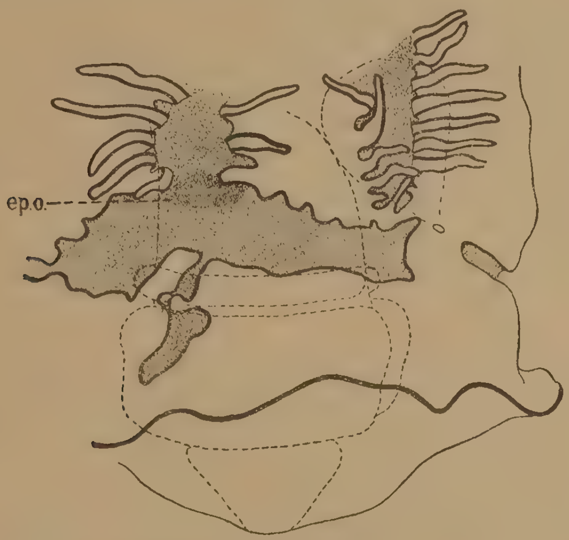
TEXT-FIG. 16.—? *Tornaria delsmanni*. Krohn stage. (× *ca.* 22.) *L.*, inferior lateral ridges, more highly magnified; *r′.*, secondary, circumanal ring.

Taken at Station 35 (3 miles East of Low Isles, 27th December, 1928), at 10.18 a.m. in the stramin net.

This fragment is probably of the same species as the other two tentaculate larvae, but no stress is laid on its identification as such.

In comparing the Barrier Reef specimens with their nearest known relatives only the Krohn-stage can be used, since this stage alone was described in *T. sunieri* (Stiasny, 1921*b*, p. 101, figs. 1–4). The Barrier Reef specimen differs from *T. sunieri*, and agrees with *T. delsmanni* in size and proportions, in the greater number of tentacles, in the presence of inferior lateral ridges, each with a short tentacle-like process, and in the shape of the inferior dorsal groove. The proboscis-coelom in T. *sunieri* is broad and rounded; it is not described in the corresponding stage of *T. delsmanni*. The apparent absence of a secondary circumanal ring in *T. delsmanni* cannot be stressed, since the material was admittedly not well preserved.

These specimens are therefore referred somewhat doubtfully to *T. delsmanni*. In any case they increase the probability of the distinctness of *T. delsmanni* and *T. sunieri*, of which Stiasny-Wijnhoff and Stiasny were not convinced.



TEXT-FIG. 17.—Fragment of a tentaculate larva in Spengel stage. (× 40.) *ep.o.*, lateral epithelial organ.

No tentaculate larva with coelom close to gut has been traced to its adult. Stiasny-Wijnhoff and Stiasny (1927, p. 189) suggest that it may be the type characteristic of the genus *Spengelia*, of which six species have been described from the Indo-Pacific region.

12. *Tornaria* sp. ? (Text-fig. 18).

Regressive stage, probably of a tentaculate larva.

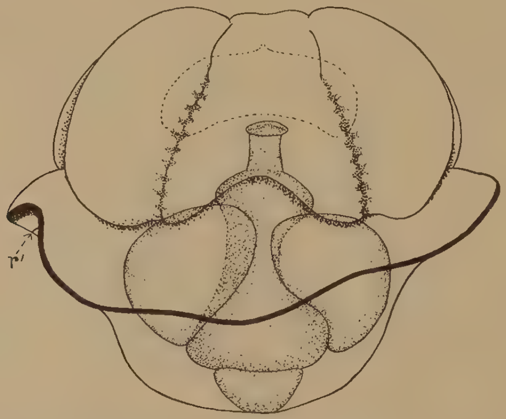
Height 2 mm.; diameter 2½ mm.

Body-wall almost opaque. Upper part of larva depressed, with apical pole invaginated; axis of anal field about ½ total height; greatest diameter at level of ciliated ring.

Grooves of oral field narrow, overhung by the swollen ridges, on the borders of which no ciliated bands are visible. Praeoral field of anchor-shaped type. Oral arch low, wide. Inferior lateral groove a slight radial depression. Inferior dorsal groove, if present, merged in the general constriction of this zone. Tentacles reduced to almost imperceptible, low bosses; approximate tentacle formula V. 9 to 11, 9 to 11; L. ? 4, ? 4; D. 8 to 10, 8 to 10. Circular ciliated band broad. A secondary, transparent circumanal ring within this, distant from it only a little more than width of ciliated band.

Proboscis-coelom well developed ; shape doubtful. A pair of large coelomic pouches close to gut. Collar-coelom ?. Stomach large, constricted by the coelomic pouches ; hind-gut small, conical.

A single specimen from Station 19 (16° 20′ S., 146° 3′ E.), taken 20th October, 1928, at 11.42 a.m. in the Nansen vertical net (180 metres of wire out).



Text-fig. 18.—*Tornaria* in regressive stage. Ventral view. (× 30.) *r′*. Secondary circumanal ring.

It is impossible to relate this larva with certainty to any other. The position of the coelom and of the circumanal transparent ring suggest the tentaculate larvae referred to *T. delsmanni*, but the shape of the anal field and relative size of the diameter of the main ciliated ring are very different. The distance between the developmental stages represented makes comparison difficult, and if the tentaculate fragment from Station 35 is specifically identical with the younger specimens, the older larva is almost certainly distinct.

REFERENCES.

Boulenger, G. A. 1910. Les Batraciens. Encyclopédie Scientifique, Paris, pp. 1–305.

—— and Annandale, N. 1918. Rec. Ind. Mus. XV, pp. 51–67.

Bourne, G. C. 1889. On a Tornaria found in British Seas. J. Marine Biol. Ass. (2) I, pp. 63–68, pls. vii, viii.

Calman, W. T. 1909. Crustacea, in Lankester's Treatise on Zoology, VII (3), pp. 1–346.

Dakin, W. J. 1916. A New Species of Enteropneusta, *Ptychodera pelsarti*, from the Abrolhos Islands. J. Linn. Soc. Zool. London, XXXIII, pp. 85–100, pls. i, ii.

Eschscholtz, Fr. 1825. Oken's Isis, p. 740, pl. v, fig. 8.

Giard, A. 1891. Sur le bourgeonnement des larves d'*Astellium spongiforme* Gd. et sur la Poecilogonie chez les Ascidies composées. Comptes Rendus de l'Ac. Sci., Paris, CXII, pp. 301–304.

—— 1892. Nouvelles Remarques sur la Poecilogonie. Comptes Rendus de l'Ac. Sci., Paris, CXIV, pp. 1549–1552.

Gravier, C. 1905. Sur le *Ptychodera erythraea* Spengel. Bull. Soc. Philom. Paris (sér. 2), VII, pp. 69–74, 4 figs.

Hill, J. P. 1897. The Enteropneusta of Funafuti. Mem. Austral. Mus. III, pp. 203–210, pl. ix.

Horst, C. J. van der. 1924. West-indische Enteropneusten. Bijdr. tot de Dierkunde, XXIII, pp. 33–60, pls. iv–vii.

—— 1930. Papers from Dr. Mortensen's Pacific Expedition 1914–16 : LI, Observations on some Enteropneusta. Vidensk. Medd. naturh. Foren, Kjob. LXXXVII, pp. 135–200, figs. 1–64.

KLUNZINGER, C. B. 1902. Über *Ptychodera erythraea* Spengel aus dem Rothen Meere. Verh. Deutsch. Zool. Ges. XII, pp. 195–202, figs. 1–4.

MACBRIDE, E. W. 1920. Larvae of Echinoderma and Enteropneusta. British Antarctic (" Terra Nova ") Exped. 1910, Nat. Hist. Rep., Zool. London, IV (3), pp. 83–94, pls. i, ii.

MASER, O. 1913. Über *Balanoglossus carnosus* (Willey) und eine ihm nahestehende, neue Art von Neucaledonien. Zool. Jahrb. Abt. Anat. XXXIII, pp. 361–430, pls. xxv–xxix.

MENON, K. R. 1903. Enteropneusta from Madras. Quart. J. Micr. Sci., London, XLVII, pp. 123–131, pl. x.

MIYASHITA, Y. 1925. Über Tornaria-Larven aus Japanischen Küste. Dobutsugaka Zasshi, Tokyo, XXXVII, No. 438. [Not seen. Quoted from Stiasny, 1928.]

MORGAN, T. H. 1894. The Development of *Balanoglossus*. J. Morph. IX, pp. 1–86, pls. i–vi.

PUNNETT, R. C. 1903. The Enteropneusta. In Gardiner, J. S., Fauna and Geog. Maldive and Laccadive Archipelagoes, II, pp. 631–680, pls. xxxvii–xlvi, Cambridge.

RITTER, W. E. 1894. On a new *Balanoglossus* Larva from the Coast of California, and its Possession of an Endostyle. Zool. Anz. XVII, pp. 24–30, figs. 1, 2.

—— and B. M. DAVIS. 1904. Studies on the Ecology, Morphology and Speciology of the Young of some Enteropneusta of Western North America. Univ. Calif. Publ. Zool. I (5), pp. 171–210, pls. xvii–xx.

SCHMARDA, L. K. 1871–2. Zoologie, I, p. 273 [Not seen. Quoted from Spengel, 1904*c*.]. 2nd edn. 1877, pp. 367–369, fig. 237.

SPENGEL, J. W. 1893. Fauna and Flora Neapel, XVIII, Enteropneusten, pp. xii, 756 [2], 36 pls. (col.), 1 map.

—— 1903. Neue Beiträge zur Kenntniss der Enteropneusten. 1. *Ptychodera flava* Eschscholtz, von Laysan. Zool. Jahrb. Abt. Anat. XVIII, pp. 271–326, pls. xxiv–xxix.

—— 1904*a*. Neue Beiträge . . . 2. *Ptychodera flava* von Funafuti. Zool. Jahrb. Abt. Syst. XX, pp. 1–18, pl. i, ii.

—— 1904*b*. Neue Beiträge . . . 4. *Ptychodera erythraea*. Zool. Jahrb. Abt. Syst. XX, pp. 413–428, figs. A, B.

—— 1904*c*. Eine wieder aufgefundene Enteropneusten-Art (*Balanoglossus tricollaris* Schmarda). Zool. Anz. XXVIII, pp. 52–54.

STIASNY, G. 1921*a*.* Über westindische Tornarien nebst einer Übersicht über die bisher bekannten tentaculaten Tornarien. Versl. gewone Akad. Amsterdam, XXIX (also in Proc. R. Acad. Amsterdam, XXIII, 1921, pp. 2–36, pls. i, ii, figs. 1–3).

—— 1921*b*. Eine neue Tornaria aus dem ostindischen Archipel (*Tornaria sunieri*). Zool. Meded. Leiden, VI, pp. 101–108, figs. 1–4.

—— 1922.* Die Tornarien-sammlung von Dr. Th. Mortensen. Vidensk. Medd. naturh. Foren. Kjob. LXXIII, pp. 123–137, figs. 1–9.

—— 1928. Tornarien von Japan. Zool. Jahrb. Abt. Syst. LVI, pp. 67–92, figs. 1–19.

STIASNY-WIJNHOFF, G., and STIASNY, G. 1926. Über Tornarientypen und ihre Beziehung zur Systematik der Enteropneusten. Zool. Anz. LXVIII, Leipzig, pp. 159–165, figs. 1–9.

—— 1927. Die Tornarien. Kritik der Beschreibungen und Vergleich sämtlicher bekannter Enteropneusten-Larven. Ergebn. Fortschr. der Zool. VII, Jena, pp. 38–208, figs. 1–78, 7 charts.

WILLEY, A. 1897. On *Ptychodera flava* Eschscholtz. Quart. J. Micr. Sci. London, XL, pp. 165–183, pl. 5.

—— 1899. Enteropneusta from the South Pacific, with Notes on West Indian Species. Willey, A., Zoological Results, Part III, pp. 223–334, pls. xxvi–xxxii.

* These dates are taken from the wrappers of parts of the respective periodicals. They are each a year later than those quoted by Stiasny-Wijnhoff and Stiasny (1927), which may perhaps be the dates when the papers were read. 1921*a* has been seen by me in ' Proc. R. Acad. Amsterdam ' only.

TUNICATA

BY

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WITH SEVENTEEN TEXT-FIGURES AND THREE PLATES.

The Tunicata form two ecological groups which coincide with important systematic divisions, the Ascidiacea being benthic, the Thaliacea and Appendicularia planktonic. It will be convenient to treat these groups separately.

ASCIDIACEA.

The value of the collections of the Barrier Reef Expedition is enhanced by the quantity of ecological observations accompanying them, which can be found in the general reports. They are also important as coming from one of the parts of the Australian coast whose Ascidian fauna is less well known, our knowledge depending chiefly on Herdman's Catalogue (1899), which needs revision. The Ascidians of the N.W. and S.W. coasts have recently been studied by Hartmeyer (1919), Hartmeyer and Michaelsen (1928) and Michaelsen (1930).

Geographical Distribution.

From its position at the N.E. corner of Australia, the fauna of the Great Barrier Reef might be expected to show affinities with the Malayan as well as the Australian fauna, and this intermediate position gives it some interest. Until more is known of the species described by Herdman (1882*b*, 1886, 1899) and Sluiter (1895, 1904, 1909), no exact account of the distribution of Tunicates in the Australian and Malayan regions can be given. It is worth noticing, however, that, of the 36 species of Ascidians in the collection, 21 were already known from the Australian coasts and 17 from Malaya. Hartmeyer and Michaelsen (1928, p. 257) also found a relationship between the Australian (W. Australian) tunicate fauna and that of Malaya.

There are only 7 species in the Barrier Reef collection that have not been found beyond the coasts of Australia, and several are widely distributed in the Indian Ocean, some extending as far as Africa. Records of Australian species in the Atlantic are not numerous and are not generally very convincing. It seems probable, however, that some (*e. g. Ascidia sydneiensis*) really have this very wide distribution. The synonymy of the Tunicata is, however, still too uncertain for detailed discussion to be profitable.

Parasitic and Commensal Associates of the Ascidiacea.

Various parasitic and commensal animals were associated with the Ascidians. They will be included in the appropriate reports of the Barrier Reef Expedition. A list follows:

Lamellibranchs were embedded in the test of specimens of *Polycarpa cryptocarpa* (St. XIX) and *Cnemidocarpa irma* (St. XIX).

The specimen of *Polycarpa procera* (St. XXV) had a Gymnoblastic Hydroid growing on the inner surface of the branchial siphon.

Commensal Amphipods were found in the branchial sac of *Phallusia depressiuscula* (St. XIX), *Polycarpa pedata* (St. XVI) and *Cnemidocarpa irma* (St. XIX, XXII), and in the atrial siphon of *Polycarpa aurita* (St. XIX).

Decapoda natantia were living in the cloacal canals of *Sigillina deerrata* (St. XVII). Individuals belonging to the genus *Pontonia* were present in the branchial sac of *Phallusia depressiuscula* (St. VIII) and *Pyura momus* form *grandis* (St. XIX, XXII).

Parasitic Copepods of the family Notodelphyidae were found in the branchial sac of *Podoclavella meridionalis* (St. XXII) and of both specimens of *Phallusia depressiuscula* (St. VIII, XIX). Specimens of *Polycarpa cryptocarpa* (St. XIX) contained a parasitic Crustacean resembling *Sphaerothylacus polycarpae* Sluiter.

Zooxanthellae have been found in three species of Tunicate from the reef submitted to Dr. C. M. Yonge, namely *Trididemnum cyclops* (p. 89), *Didemnum voeltzkowi* (p. 97) and *Diplosoma virens* (p. 102). The algae are not all of the same kind.

Type-Specimens.

The Amsterdam Museum very kindly lent me type-specimens of the following species described by Sluiter: *Styela aurita*, *S. albopunctata*, *Ascidia limosa*, *Distoma deerratum*, *Polycitor coalitus*, *Didemnum reticulatum*, *D. jedanense*, *D. chartaceum*. They also arranged an exchange of specimens by which we now have examples of most of the species of Appendicularians found by the Siboga and slides of the compound Ascidians mentioned above.

Collecting Stations.

Ascidians were obtained by shore collecting at Batt Reef, Yonge Reef, Three Isles and Low Isles. They were obtained at the following places on Low Isles: A4, F9, between F11 and IR1, G3, IM1, RC, the Sand Flat, the Thalamita Flat, the Mangrove Swamp. The symbols refer to the map of Low Isles given in Dr. Stephenson's Report on the Ecology of the Reef, where particulars of all shore collecting stations will be found.

They were collected by dredge or trawl from the following stations:

II. 24.ii.28. Linden Bank, 28 fath., shell and sand, dredge 10 min. and 5 min.
VIII. 21.ii.29. 1½ miles N.W. Low Isles, 11 fath., mud, Agassiz trawl, 30 min.
IX. 22.ii.29. Penguin Channel, 12–14 fath., clean pit with mud at sides, 6 dredges about 20 min. each.

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XII. 24.ii.29. Penguin Channel, 10–15½ fath., rock and shell gravel, mud on edges of pit, 5 dredges about 30 min. each.

XVI. 9.iii.29. About ½ mile W. of N. Direction I., 20 fath., stony, 6 dredges 20–30 min. each.

XVII. 9.iii.29. About ¼ mile N. of N. Direction I., 19 fath., sand, thick *Halimeda*, 2 dredges 40 min. each.

XIX. 10.iii.29. About ½ mile N. Eagle I., 10 fath., shell gravel, rich *Halimeda*, 3 dredges, 20–30 min.

XXI. 11.iii.29. ½ mile N.W. Howick Is., 10 fath., mud and shell, Foraminifera, 2 dredges, 30 and 40 min.

XXII. 11.iii.29. To East of Snake Reef, 13½ fath., mud with Foraminifera and shells, 2 dredges ½ hour each.

XXIII. 12.iii.29. In lee of Turtle Isles, 8 fath., mud and shell, 3 dredges, 30–45 min.

XXV. 17.iii.29. In Papuan Pass, 20–25 fath., Foraminifera and coral fragments, series of dredgings, 2¼ hours in all.

Nomenclature.

The subdivisions of species have been called subspecies, variety or form according to the usage of their authors, and it is therefore probable that, in this paper, they have no uniform significance.

Species of Ascidians in the Collection.

Ptychobranchiata.

Pyuridae.
Pyura momus form *grandis* (Heller).
Microcosmus helleri Herdman.

Styelidae.
Cnemidocarpa irma Hartmeyer.
Polycarpa aurata (Quoy & Gaimard).
P. pedata Herdman.
P. ovata Pizon.
P. fungiformis Herdman.
P. cryptocarpa (Sluiter).
P. aurita (Sluiter).
P. procera (Sluiter).

Polyzoidae.
Chorizocarpa sydneyensis (Herdman).

Botryllidae.
Botryllus gracilis Michaelsen.
B. magnicoecus (Hartmeyer).

Dictyobranchiata.

Ascidiidae.
Ascidia sydneiensis Stimpson.
A. granosa Sluiter.
Phallusia depressiuscula (Heller).
P. julinea Sluiter.

Krikobranchiata.

Clavelinidae (in the sense of Michaelsen, 1930).
Podoclavella meridionalis Herdman.
P. molluccensis Sluiter.
Eudistoma ovatum (Herdman).
Sigillina deerrata (Sluiter).

Didemnidae.
Trididemnum cyclops Michaelsen.
T. savignii (Herdman).
T. natalense Michaelsen.
Leptoclinides reticulatus (Sluiter).
L. lissus sp. n.
Didemnum candidum Savigny.
D. psamathodes var. *skeati* (Sollas).
Didemnum voeltzkowi Michaelsen.
D. chartaceum Sluiter.
D. jedanense Sluiter.
D. (*Polysyncraton*) *magnetae* sp. n.
Diplosoma spongiforme Giard. var. ? Michaelsen.
D. virens (Hartmeyer).
Diplosomoides ostrearium Michaelsen.

Polyclinidae.
Polyclinum macrophyllum subsp. *phortax* Michaelsen.

Pyura momus form *grandis* (Heller).

Cynthia grandis Heller, 1878, p. 97, pl. v, fig. 26.
Pyura momus form *grandis* Hartmeyer & Michaelsen, 1928, p. 441 (synonymy).

Distribution.—E. and S.W. Australia.

Occurrence.—St. XVII (1 specimen), XIX (4 specimens), XXII (5 specimens).

All these specimens have the long processes of irregular shape and distribution on the rim of the anus characteristic of form *grandis*.

One of the specimens from St. XIX has 11 folds on each side of the branchial sac, the other has 12. The convolutions of the ciliated band on the dorsal tubercle are very complicated. The test is dark and rough.

The specimens from St. XVII and XXII are smaller, paler and smooth, but they have 10 or 11 folds on each side of the branchial sac, and their dorsal tubercles, though less complicated than those from St. XIX, are more so than that figured by Herdman (1882*b*, pl. xvii, fig. 9, *Cynthia complanata* = *P. momus* form *grandis*).

The specimens all show the chief characteristics of form *grandis*, and the differences among them may be due to age.

According to Hartmeyer and Michaelsen (1928, p. 440), form *grandis* is a southern cool-water form replaced in the warmer waters of North Australia by form *galei*. These specimens, however, come from the tropical seas of the Barrier Reef, and yet resemble *grandis* rather than *galei* in all points of contrast between these two forms.

Microcosmus helleri Herdman.

Microcosmus helleri Herdman, 1882*a*, p. 54; 1882*b*, p. 131, pl. xiv, figs. 1–4; Hartmeyer, 1919, p. 19, pl. i, figs. 6–9; Van Name, 1924, p. 31; Hartmeyer & Michaelsen, 1928, p. 397 (synonymy).

Distribution.—Cape Jaubert, Torres Straits, Malaya, E. Africa, Curaçao.

Occurrence.—St. XIX (5 specimens), XVI (1 specimen), IX (1 specimen).

These specimens agree very closely with the description of *M. helleri* given by Hartmeyer (1919). The number and arrangement of the longitudinal bars shows general, though not exact, agreement with Hartmeyer's table. The test is thickly covered with shell fragments, etc.

Cnemidocarpa irma Hartmeyer. (Text-fig. 1.)

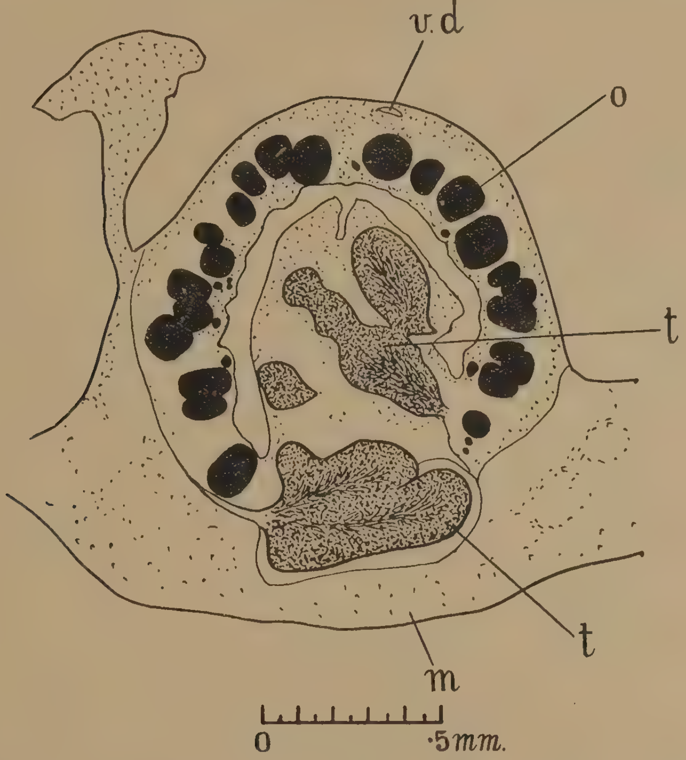
Cnemidocarpa irma Hartmeyer, 1927, p. 168; Hartmeyer and Michaelsen, 1928, p. 388, figs. 40–42.

Distribution.—S.W. Australia.

Occurrence.—St. XIX (8 specimens), XXII (10 specimens).

The internal structure of these specimens falls within the range of variation attributed to this species by Hartmeyer, but they differ in their external form, for they appear to have been unattached and are thickly coated with coarse shell fragments, etc. Where the test is visible it corresponds to Hartmeyer's description. There is general agreement in the structure of the mantle, branchial sac and gut. The dorsal tubercle may be round or oval, with the tips of the arms meeting or with one curved in. As in Hartmeyer's specimens, there are three elongated gonads on the right side, one of which may be subdivided, and two on the left. Hartmeyer's description does not make the arrangement of the ovarian and testicular tissue in the gonad clear, but it appears that the bulk of the testicular tissue is on the outside. If this is so the present specimens differ. In them the testis forms a core covered by a layer of ovarian tissue, only the vas deferens and the vasa efferentia running outside the ovary (Text-fig. 1). The eggs are arranged in an irregular single layer, and the testes from the two sides overlap each other (*cf.* Huntsman, 1913, p. 486).

There is one specimen from St. XIX in which the muscle-bundles in the mantle are rather less distinct and the longitudinal vessels are slightly more numerous. In this specimen the gonads are more numerous and shorter. There are 9 more or less oval gonads on one side, and 13 on the other, some groups having a common duct. In view of Hartmeyer's figure 42 this does not seem a sufficient reason for treating the specimen as distinct. Internally these gonads only differ from those of the other specimens in the more lobed testis.



TEXT-FIG. 1.*—*Cnemidocarpa irma* Hartmeyer. Transverse section of a gonad.

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* *Key to lettering of Text-figures.*—*a.*, anus; *ab.*, abdomen of Crustacean; *b.*, bud; *c.*, cavity in test; *c.f.*, ciliated funnel; *cl.*, cloacal canal; *cr.* Crustacean; *f*, follicle; *g*, gonad; *i*, intestine; i. 1, 1st section of the intestine, "nachtmagen"; i. 2, 2nd section of the intestine, "drusenmagen"; *l.*, lamina on transverse bar; *m.*, mantle; *o.*, eggs; *o.d.*, oviduct; *oe.*, œsophagus; *p.*, peripharyngeal bands; *r.*, rectum; *s.*, stomach; *s.v.*, stalked vesicles; *t.*, testis; *t.i.*, tissue surrounding intestine; *t.t.*, thoracic tubercle; *t.z.*, tentacular zone; *v.*, vascular process; *v.d.*, vas deferens.

Polycarpa aurata (Quoy & Gaimard).

Ascidia aurata Quoy & Gaimard, 1834, p. 604, pl. xci, fig. 3.
Polycarpa aurata Hartmeyer, 1919, p. 40 (synonymy, except *P. pedata* Herdman); Sluiter, 1919, p. 3.

Distribution.—Oceania, N.E. and E. Australia, Malaya, Indian Ocean.

Occurrence.—Outer Region, Batt Reef (4 specimens).

These specimens all have a rather smooth test and a hump beside the atrial aperture. The structure of the test and the internal anatomy agree well with the descriptions of Herdman (*P. sulcata*) and Hartmeyer. The collector notes their colour in life as yellow with purple streaks, the characteristic coloration figured by Quoy and Gaimard.

Polycarpa pedata Herdman.

Polycarpa pedata Herdman, 1882*a*, p. 71; 1882*b*, p. 180, pl. xxiv, figs. 1, 2; Van Name, 1918, p. 97, pl. xxiii, figs. 1–3 (synonymy).

Distribution.—E. Australia, Malaya.

Occurrence.—St. XVI (1 specimen).

This specimen, which has the external appearance of *P. pedata*, also differs from the Barrier Reef specimens of *P. aurata* in the internal characters noticed by Van Name, namely more numerous longitudinal vessels, short rectum, gonads longer and anastomosing. There is also a difference in the test, that of *P. pedata* being thinner and free from the knobbed ends of the vessels that give a spotted appearance to a cut surface of that of *P. aurata*. Examination of the type of *P. pedata* (B.M. 87.2.4.125) shows that it has a similar thin test, and so has the only other specimen available for comparison (B.M. 80.11.19.5 from Port Phillip Heads). It seems possible, therefore, that this is another point of distinction between these two forms.

Polycarpa ovata Pizon. (Plate I, figs. A and B.)

Polycarpa ovata Pizon, 1908, p. 211, pl. xi, figs. 15–20; Van Name, 1918, p. 101, pl. xxxi, fig. 31, text-figs. 53–55.

Distribution.—Amboina, Philippines.

Occurrence.—St. XVI (1 specimen).

This specimen agrees fairly well with the descriptions of Pizon and Van Name. Externally (Plate I, fig. A) it is smoother and it is attached by a cluster of rooting processes. The dorsal tubercle has the tip of its right arm curved outwards. The gut is of remarkably small size and has an endocarp in the first loop. Van Name describes more longitudinal vessels between the folds than Pizon does. In this and in the position of the atrial orifice (Plate I, fig. B) the Barrier Reef specimen agrees with Pizon's. The folds of the branchial sac resemble Pizon's in projecting very slightly and being broad at the base. The mantle consists of an outer layer of transverse muscle, a middle layer of longitudinal muscles and an inner spongy layer.

The agreement with the published descriptions not being complete and material for comparison not being available, this determination is tentative.

Polycarpa fungiformis Herdman.

Polycarpa fungiformis Herdman, 1899, p. 43, pl. Cyn. xvi, figs. 1–10.

Distribution.—Moreton Bay, Queensland.

Occurrence.—St. XXV (1 specimen).

This specimen agrees exactly with Herdman's description, except that the dorsal fold on each side projects like the others.

The brown dots are found, not only in the mantle, but in the tissues of the branchial sac and endostyle.

Polycarpa cryptocarpa (Sluiter).

Styela cryptocarpa Sluiter, 1886, p. 210, pl. ii, fig. 1, pl. vii, figs. 1–3; 1891, p. 333.
Polycarpa cryptocarpa Hartmeyer, 1907, p. 17.
Pandocia (*Polycarpa*) *cryptocarpa* Michaelsen, 1911, p. 152.

Distribution.—Billiton Is. (Dutch E. Indies), Japan.

Occurrence.—St. II (1 specimen), St. XIX (3 specimens).

These specimens agree very closely with Sluiter's description. All those from St. XIX contain parasitic Crustacea resembling *Sphaerothylacus polycarpae* Sluiter, which was originally discovered in the type of *P. cryptocarpa*.

Polycarpa aurita (Sluiter). (Text-fig. 2 a–c.)

Styela aurita Sluiter, 1891, p. 338, pl. ii, fig. 12.
Polycarpa aurita Hartmeyer, 1919, p. 81, pl. ii, figs. 43–47 (synonymy); Sluiter, 1919, p. 3.

Distribution.—N.W. Australia, Malaya.

Occurrence.—St. IX (1 specimen), XXIII (2 specimens), XIX (1 specimen).

The main part of the test of these specimens (except the one from St. XIX, which differs in various ways) is very dark brown, and the siphons and surrounding areas are deep buff colour. They are rather darker than Sluiter's types, kindly lent to me by the Amsterdam Museum. Those described by Hartmeyer have the lighter colour of the types. Posteriorly there is a distinct, flattened stalk with root-like processes at its end, In the specimen from St. IX the siphons are fairly prominent; in the others they are quite flat.

In internal structure these specimens agree with Hartmeyer's description. The dorsal tubercle is of the type figured by Hartmeyer, but the ciliated groove has no wider middle portion. Hartmeyer found a similar dorsal tubercle in one of the original specimens, but this is not the pattern in the holotype,* and a paratype examined by me (Text-figs. 2 a, c). In them there is a T-shaped ridge projecting inwards from the left side of the tubercle, with curled arms. The groove, therefore, describes a double spiral rather than a series of loops. The endostyle in the types and in the Barrier Reef specimens consists of a pair of tumid ridges with a narrow groove between. The ridges become less tumid posteriorly.

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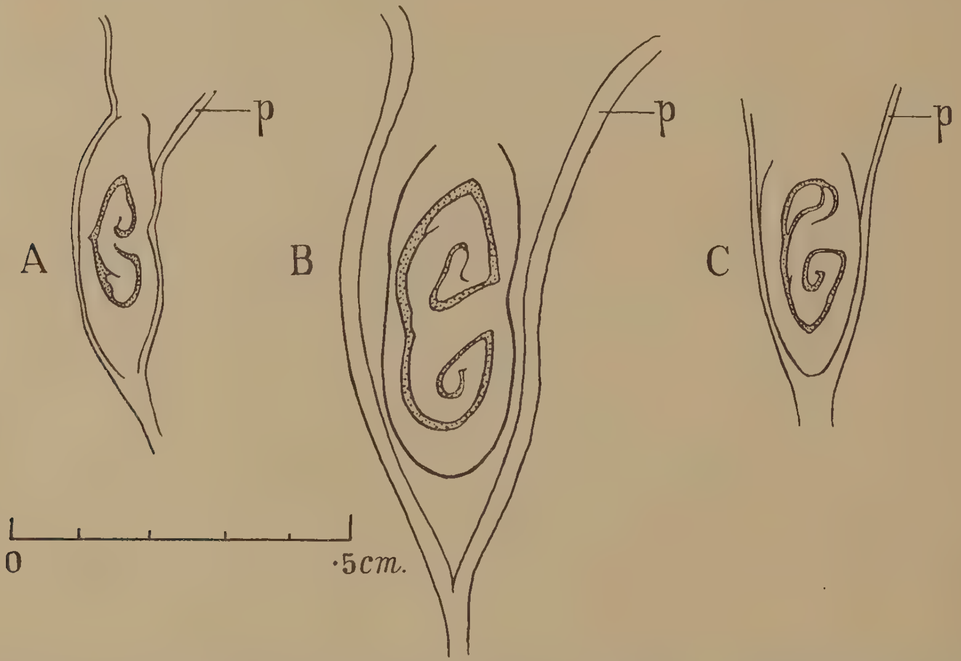
* Three unopened specimens, one of which I opened, and an open one, which I take to be the holotype, were lent to me.

The specimen from St. XIX measures 8·5 × 2·5 cm. and has no stalk. It differs from the other specimens of *S. aurita* chiefly in the branchial sac, which has much more numerous longitudinal vessels. The limits of the folds are so indistinct and the longitudinal vessels so numerous that accurate counting is impossible. There are roughly 40 vessels in the space between each pair of folds and 50 to 60 on each fold. The tentacles are small and fine, scarce and unevenly distributed, there being eight on the ventral side and none on the dorsal. Those of the type-specimens are evenly distributed, and may be thick (type) or thin (paratype). The dorsal tubercle is of the kind with a T-shaped ridge, but the arms are more coiled and both turn to the left (Text-fig. 2 B).



Text-fig. 2.—*Polycarpa aurita* (Sluiter). Dorsal tubercle. A, Holotype. B, Specimen from St. XIX. C, Paratype. *p.*, peripharyngeal band.

Styela circumarata Sluiter (1904, p. 70) appears to be a closely related species.

The test round the branchial orifice of the specimen from St. IX bears Polyzoa of the genus *Nolella* (*Cylindroecium*).

Polycarpa procera (Sluiter). (Text-fig. 3.)

Styela procera Sluiter, 1886, p. 196, pl. i, fig. 9, pl. v, figs. 5–9.
Polycarpa procera Hartmeyer, 1919, p. 52, pl. i, figs. 24–26, text-figs. 5–13; Hartmeyer & Michaelsen, 1928, p. 378.

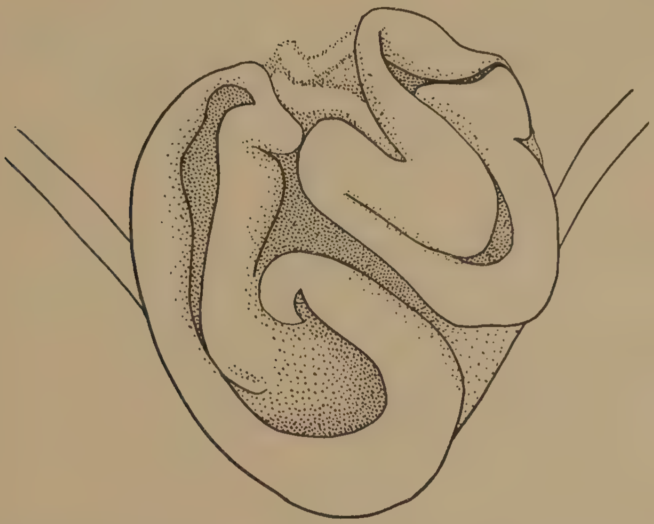
Distribution.—Australia, Malaya.

Occurrence.—St. XXV (1 specimen).

This specimen resembles Hartmeyer's Text-fig. 7 in form, but the ventral end is somewhat turned towards the atrial orifice. The convex antero-ventral edge so produced bears a thick band of coarse sand and shell fragments. The rest of the test is uniformly coated with sand and is brittle. The internal structure corresponds to Hartmeyer's description. The branchial sac is extremely transparent. The gut has the course shown by Hartmeyer in pl. i, fig. 26. There are twelve gonads on each side. The velum is wide and produced into two lobes, a blunt one on the dorsal side of the atrial aperture and a pointed one on the ventral side.

The dorsal tubercle (Text-fig. 3) resembles Sluiter's in being very irregular, but the pattern is quite different.

The lining of the branchial siphon bears a thick growth of a Gymnoblastic Hydroid.



Text-fig. 3.—*Polycarpa procera* (Sluiter). Dorsal tubercle. Actual length of longest diameter, 1 mm.

Chorizocarpa sydneyensis (Herdman).

Chorizocormus sydneyensis Herdman, 1899, p. 95, pl. Pst. i, figs. 1–7.
Chorizocarpa sydneyensis Michaelsen, 1904, p. 93, pl. ii, figs. 24–26 (synonymy).

Distribution.—Port Jackson.

Occurrence.—Yonge Reef.

Botryllus gracilis Michaelsen. (Text-fig. 4 a–e.)

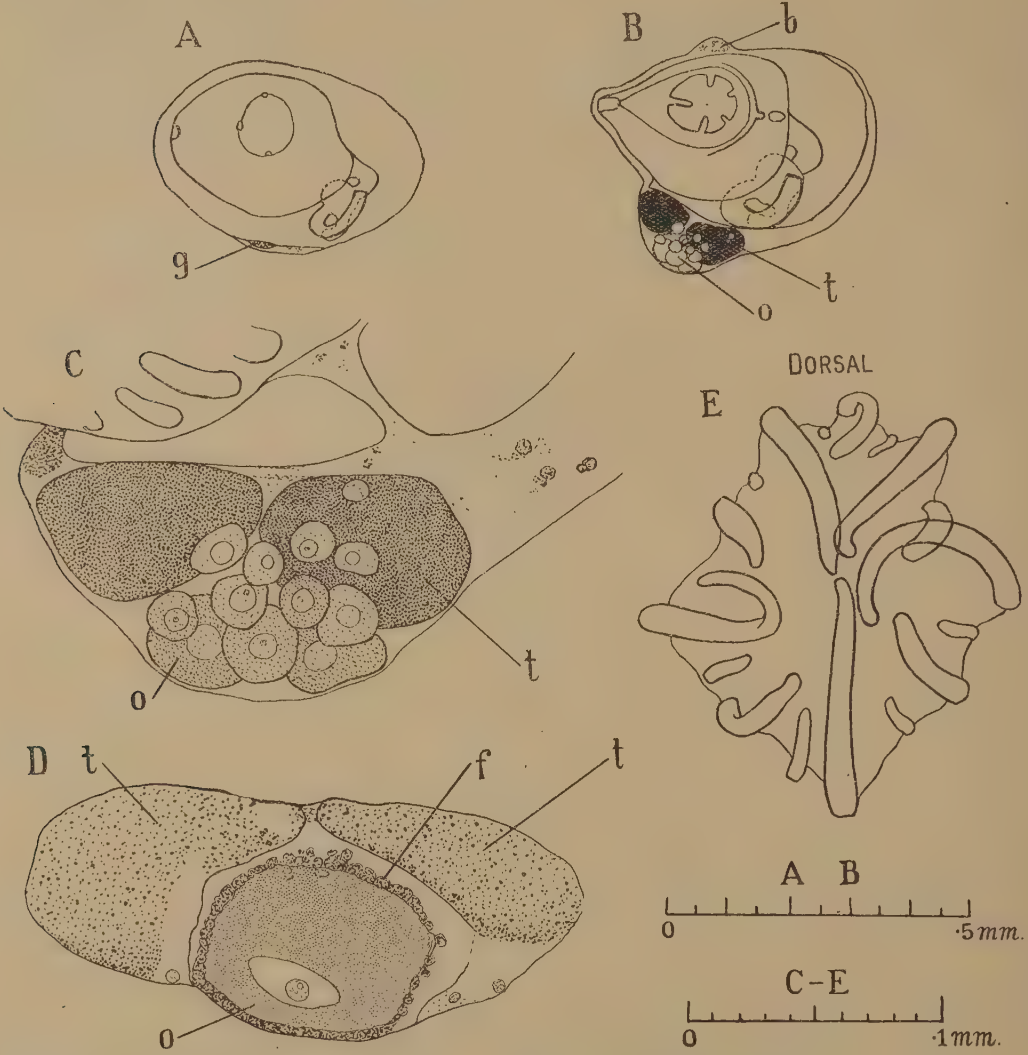
Botryllus gracilis Michaelsen, 1927, p. 203; Hartmeyer & Michaelsen, 1928, p. 338, fig. 22.

Distribution.—Shark's Bay, S.W. Australia.

Occurrence.—St. XXII, on sponge.

The formation of buds at the centre of the primary systems was not seen, but the agreement in other ways is so close as to leave no doubt of the identity of these specimens with Michaelsen's species. The long atrial siphon and the form of the stomach and caecum are specially characteristic points.

The tentacles are remarkable in that, although they occupy the positions in which they are usually found in *Botryllus*, they develop in sets of five instead of four, and, since their relative sizes depend on the order of their development, the distribution of large and small ones in the adult zooid is different (Text-fig. 4 E). In Text-fig. 4 B the first five are formed, and in Text-fig. 4 A only the first three are distinguishable.

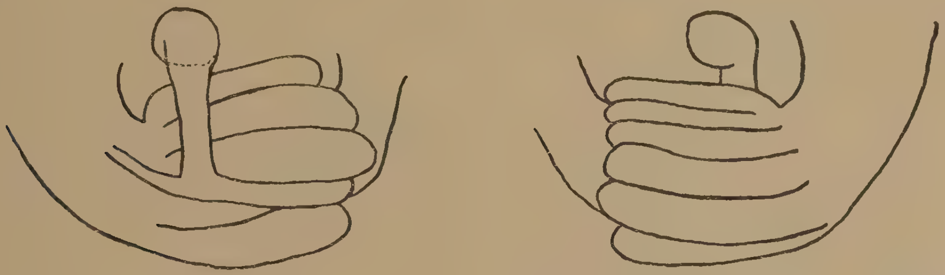


TEXT-FIG. 4.—*Botryllus gracilis* Michaelsen. A, Slightly oblique view of young zooid with first rudiment of gonad. Details of branchial sac omitted. B, Similar view of older zooid. C, Part of B, more highly magnified. D, Parasagittal section of gonad of still older zooid. E, Tentacles. (For explanation of lettering, see footnote, p. 73.)

The animals are hermaphrodite. Michaelsen found the gonads of one side usually more developed than those of the other, which were often completely absent.

In the present specimens gonads are developed on the left side only. A small bud occupies a corresponding position on the right side. In the zooids without gonads a bud is occasionally developed on the left side.

In the earliest stage seen the gonad is represented by a thickening of the inner wall of the mantle (Text-fig. 4 A). As the gonad develops, the mantle becomes distended till the gonad comes to lie in a wide space between the inner and the outer layer (Text-fig. 4 B, C). The testis, consisting of two follicles, occupies the inner part, and the ovary the outer. The vas deferens was not detected. The ovary at first consists of a large number of small eggs. Later, one of these increases greatly in size and becomes enclosed in a follicle. This egg comes to lie on the basal side of the testis (Text-fig. 4 D). In two such eggs a protuberance towards the inner side of the mantle was seen (*cf.* Ärnbäck, 1923, pp. 7, 14, etc.), but no trace of the formation of an oviduct. No later stage than this was found. In view of the work of Ärnbäck (1923) on the reproduction of *B. schlosseri* and *Botrylloides* (*Metrocarpa*) *leachii* particulars of other species are of much interest. It is unfortunate that the material of *B. gracilis* does not show the later stages which are of chief importance for classification. The early stages, however, afford comparisons of some interest. All three species agree in the position of the young gonads and their relation to the mantle. The development of gonads on one side only in *B. gracilis* and the double testis are obvious points of contrast. It is not clear whether the rudiments of ovary or testis appear first, but there can be no doubt that they appear at nearly the same time.



TEXT-FIG. 5.—*Botryllus magnicoecus* (Hartmeyer.) Two views of the same stomach. × 120.

Botryllus magnicoecus (Hartmeyer). (Text-fig. 5.)

Botrylloides nigrum var. *magnicoecum* Hartmeyer, 1912, p. 271, pl. xli, fig. 11 ; 1913, p. 135.
Botryllus magnicoecus Hartmeyer & Michaelsen, 1928, p. 331 (synonymy).

DISTRIBUTION.—China, Indian Ocean, Portugal ? Mediterranean ?

OCCURRENCE.—Yonge Reef.

There is one small, almost colourless colony which shows the chief characteristics of this species, namely the stomach with nine folds and a very large caecum, the test-vessels with sharply defined, spherical ends, and the branchial sac with ten rows of stigmata. It differs in the shape of the stomach, which is as long or longer than it is broad, and has the cardiac ends of the folds prominent as in *Botrylloides* (Text-fig. 5). The buds have a thickening of the mantle posteriorly on the left side.

Ascidia sydneiensis Stimpson.

Ascidia sydneiensis Stimpson, 1855, p. 387 ; Hartmeyer & Michaelsen, 1928, p. 285 (synonymy).

Distribution.—Australia, Malaya, Indian Ocean, Atlantic.

Occurrence.—St. XII (1 specimen), XXV (2 specimens).

Ascidia granosa Sluiter.

Ascidia granosa Sluiter, 1904, p. 36, pl. v, figs. 1–14 ; Hartmeyer, 1907, p. 21.

Distribution.—Malaya (Siboga stn. 310), Japan, Holothuria Bank, N.W. Australia, 34 fms. (B.M. 92.1.29.402).

Occurrence.—St. XVII (1 specimen).

This specimen agrees very closely with Sluiter's description. Its dimensions are 5 cm. × 2 cm. The test is very thin, consisting of little more than an adhesive in the interstices of the layer of shell fragments, etc. The mantle and branchial sac, though brown, are very transparent, so that the outer covering can be seen through them.

Phallusia depressiuscula (Heller). (Text-fig. 6 a.)

Ascidia depressiuscula Heller, 1878, p. 87, pl. i, fig. 3.
Phallusia depressiuscula Van Name, 1918, p. 116, pl. xxvii, figs. 10–13, text-figs. 72–74.

Distribution.—Indian Ocean, Malaya.

Occurrence.—St. VIII (1 specimen), XIX (1 specimen).

These specimens can be identified with *Ascidia depressiuscula* as described by Heller and re-described by Van Name. The dorsal tubercle is small and round, with a transverse slit-like opening, thus resembling that of *Ascidia limosa* Sluiter (1887, p. 257) rather than that of *P. depressiuscula*. According to Van Name the opening in *P. depressiuscula* may be simple V- or U-shaped. The course of the digestive tract is similar to that shown by Van Name (figs. 72 and 73), but the loops are longer and narrower (Text-fig. 6 a). The papillae of the branchial sac are as figured by Van Name and have the membrane from their convex border extending halfway to the next longitudinal vessel.

As in Heller's specimen, the blood-vessels in the test are very finely and profusely branched and are conspicuous for their dark colour, which here is dark brown in the main trunks, blackish-purple in the ramifications.

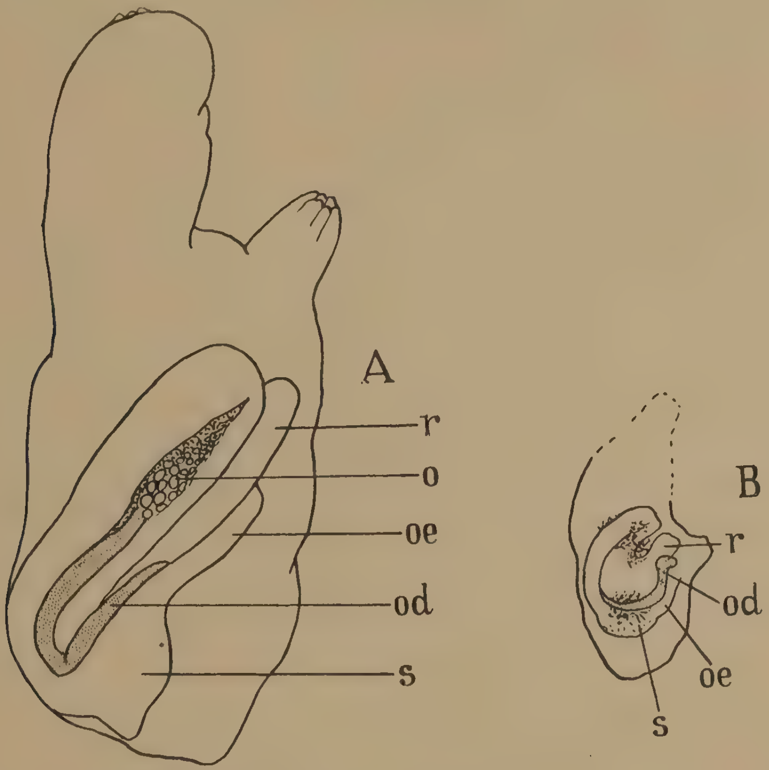
The Zoölogisch Museum, Amsterdam, kindly lent me the type-specimen of *Ascidia limosa* Sluiter for comparison with these specimens, and it seems worth while to record the following points in its structure : The animal without the test measures 2·2 cm. × 1 cm. The intestine is rather more inflated at the second bend than is shown in Sluiter's figure (Text-fig. 6 b). A thick genital duct runs between the rectum and the œsophagus. The branchial sac extends beyond the viscera posteriorly. There is a row of short transverse muscles bordering the right side of the mantle just as in *Ascidia sydneiensis*. The papillae of the branchial sac are thicker and blunter than in Sluiter's figure, and may have blunt lateral processes. They somewhat resemble those of *P. depressiuscula*, but there is no membrane extending from the papillae along the transverse vessels.

Phallusia julinea Sluiter.

Phallusia julinea Sluiter, 1919, p. 7, pl. i, figs. 13–16; Hartmeyer, 1919, p. 99, pl. ii, figs. 51–53, text-fig. 20; 1927, p. 165, text-fig. 2.

Distribution.—Java Sea, N. and E. Australia.

Occurrence.—St. IX (1 specimen), XXIII (1 specimen).



Text-fig. 6.—a, *Phallusia depressiuscula* (Heller). b, Type of *Ascidia limosa* Sluiter. Branchial region was separate, dotted outline therefore approximate. Both × 2. (For explanation of lettering, see footnote, p. 73.)

Podoclavella meridionalis Herdman. (Plate I, figs. d and e.)

Podoclavella meridionalis Herdman, 1891, p. 603; 1899, p. 4, pl. Clav. ii, figs. 1–4; Hartmeyer, 1919, p. 104.

Distribution.—Port Jackson, N.S.W., Cape Boileau (B.M. 30.9.23.7) and Cape Jaubert, N.W. Australia.

Occurrence.—St. XXII (1 specimen).

This specimen agrees very closely with Herdman's description. Its dimensions are as follows: Total length, 10 cm.; length of stalk 6·5 cm.; breadth of stalk ·2 cm.; breadth of body at widest part ·8 cm. (Plate I, fig. d). The test contains feathery crystals soluble in nitric acid, but these were not seen in the Cape Boileau specimens.

The mantle is a more or less deep purple colour over the abdomen and the sides of the thorax. Over the atrium it is colourless and transparent. In this region there are some longitudinal muscle-bands whose ends turn round and give the effect of a longitudinal row of short transverse muscle-bands, showing white against the purple sides. The horizontal membranes of the branchial sac are wide and bright yellow. Their colour can be seen externally through the transparent atrial part of the mantle as yellow stripes. The dorsal tubercle is oval, placed longitudinally, with a slit-like opening in its long axis. There are a number of embryos in the atrium.

The specimens from Cape Boileau have shorter, thicker, less horny stalks (Plate I, fig. E), less yellow pigment, and the longitudinal musculature is not so regular.

Podoclavella molluccensis Sluiter. (Plate I, fig. F.)

Podoclavella molluccensis Sluiter, 1904, p. 5; Van Name, 1918, p. 130, figs. 85–87.
Clavelina (*Podoclavella*) *meridionalis* Sluiter, 1895, p. 165, pl. vi, figs. 1–4.
Podoclavella meridionalis Pizon, 1908, p. 197, pl. ix, figs. 1–4.
non *P. meridionalis* Herdman, 1891, p. 603; 1899, p. 4.

Distribution.—Cape Boileau, N.W. Australia (B.M. 30.9.23.8), Malaya.

Occurrence.—St. XIX on *Pyura momus* form *grandis*.

The colonies are characteristic in form and colour. The yellow band below the siphons is continued as a stripe down the atrial wall as described by Pizon, and there may be a patch of yellow over the proximal end of the endostyle. The basal common test is not very thick (3 mm. at most), but the tips of the viscera are embedded in it. In the mantle there are longitudinal muscle-bands, and underneath them a more or less continuous layer of transverse muscle as described by Van Name. The longitudinal muscles can hardly be detected by reflected light and this probably led Sluiter to overlook them. Plate I, fig. F, shows the specimen from Cape Boileau.

Michaelsen (1930, pp. 466 and 476) distinguished his subfamily Clavelininae from the social forms of Polycitorinae by the unlobed branchial aperture. Van Name described his specimens as having a six-lobed branchial aperture, and Michaelsen (p. 467) would therefore put this species in *Polycitor*, but other authors describe it as plain, and it certainly is so in the present specimens.

Eudistoma ovatum (Herdman). (Plate I, fig. C; Text-figs. 7 A–C, 8 A–C.)

Psammaplidium ovatum Herdman, 1886, p. 246, pl. xxxi, figs. 13–16.
Polycitor (*Eudistoma*) *paesslerioides* Michaelsen, 1914, p. 428; 1915, p. 440; 1921*b*, p. 7 (var. *hupferi* ?).
? *Eudistoma paesslerioides* var. *hupferi* Sluiter, 1927, p. 80.

Distribution.—Torres Straits, Cape Boileau, N.W. Australia (B.M. 30.9.23.19), Indian Ocean ? W. Africa, Morocco ?

Occurrence.—St. XVII (1 colony).

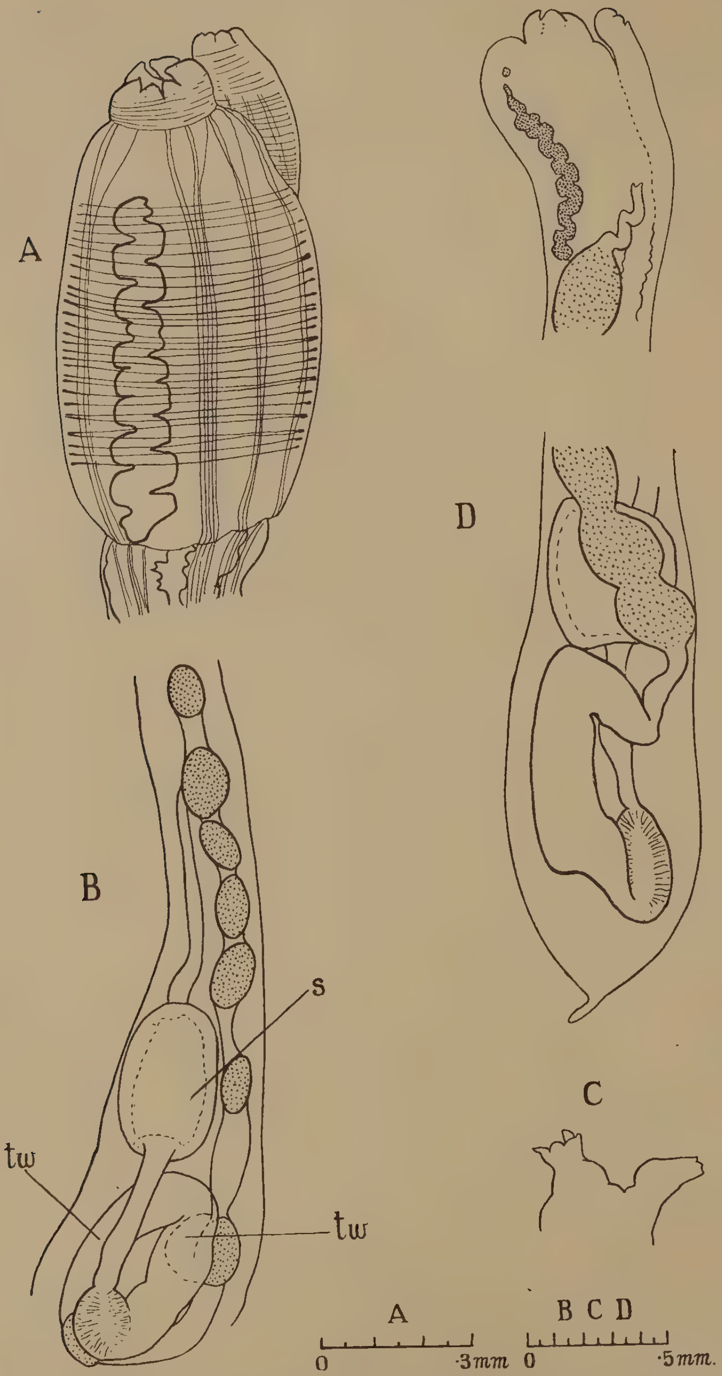
This colony, which is incomplete basally, measures 2·8 × 1·5 cm. It is club-shaped (Text-fig. 8 C), and was presumably fixed by its narrow base. The colony from Cape Boileau (Plate I, fig. C) has a diameter of 16 cm. and is 9 cm. in height. The Barrier Reef specimen agrees very closely with Herdman's types which are in the British Museum. The surface of the colony bears a regular layer of fine sand, which is only interrupted by the apertures of the zooids. Internally the sand-grains are larger and irregularly scattered. The zooids measure 8–10 mm. when well expanded. Herdman gave the length as 4 mm., and many contracted zooids in his specimens are no longer than this. Others, however, are expanded, and are as long as those from the Barrier Reef. They consist of a relatively short thorax and a very long abdomen. The end of the abdomen, containing the stomach and gonads, is as wide as the branchial sac, but the part between, through which the oesophagus and rectum pass, is narrower. This contracted part is the structure regarded by Herdman as an elongated post-abdomen. The tip of the abdomen is pointed and continued as a thread in the test for some distance. The transverse musculature on the thorax is very conspicuous on contracted zooids (Text-fig. 7 A). There are 4–6 longitudinal muscle-bundles on each side of the thorax, which coalesce to form broader bundles on the abdomen. The branchial and atrial siphons are six-lobed, and open directly on the surface of the colony.

Owing to contraction of the thorax, the arrangement of the tentacles in the type cannot be made out clearly. They are numerous and elongated. In the specimen from Cape Boileau (Text-fig. 8 A) they are arranged in several rows over a rather wide zone at the base of the branchial siphon. The short atrial siphon, at right angles to the thorax, shown in the figure is not characteristic. In most zooids it is directed forward beside the branchial siphon, and appears as long as the branchial siphon (Text-fig. 8 B), or even longer. In Herdman's specimen there are generally two complete twists in the intestinal loop (Text-fig. 7 B). One twist may occur in the Barrier Reef specimen. The difference presumably depends on the degree of contraction of the zooid. It can hardly be regarded as of systematic importance. The ovary may contain two good-sized eggs. The testis consists of numerous spherical follicles. There may be one or two embryos in the atrium, which is then more or less distended, but there is no distinct brood-pouch.

Hartmeyer (1909, p. 1470) pointed out the artificiality of the genus *Psammaplidium*. There can, I think, be no doubt of the propriety of putting *P. ovatum* in *Eudistoma*, whatever views may be held about the relation of that subgenus to the other Polycitorinae (see Michaelsen, 1930, p. 476).

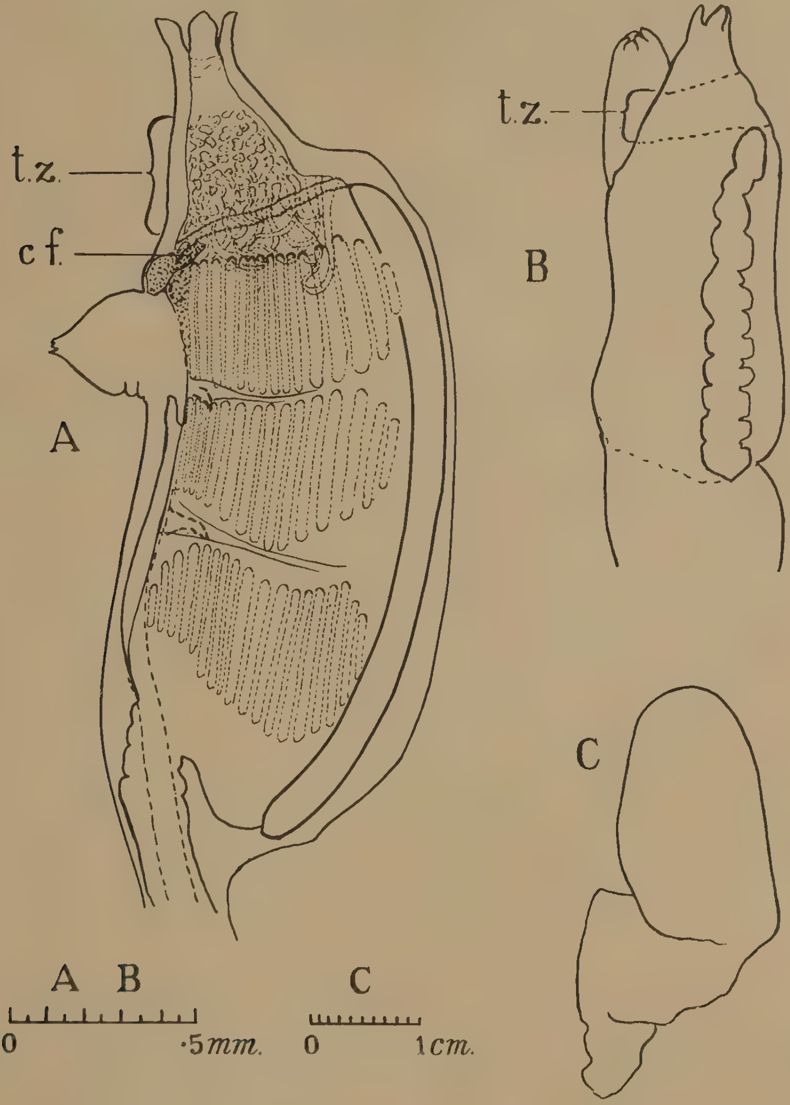
The species identified with *Psammaplidium ovatum* Herdman by Sluiter both appear to be distinct. In that from Torres Strait (1895, p. 170, pl. vii, figs. 3–5) the zooids have a post-abdomen, an atrial languet, longitudinal folds on the stomach, and more than three rows of stigmata. That from between Sumbawa and Celebes (1909, p. 100) evidently had short zooids, for he says that it agrees with Herdman's description and it is included in *Aplidium*. I have, on the other hand, no doubt that *Polycitor* (*Eudistoma*) *paesslerioides* Michaelsen is a synonym of *E. ovatum*. It is not clear to which, if any, of Michaelsen's varieties of *E. paesslerioides* the Australian specimens belong, and he says himself (1930, p. 492) that some of his varieties may be found not to stand. The small number of longitudinal and transverse muscle-bundles bring the type-specimen of *E. ovatum* nearer to var. *hupferi*, and this view is supported by the only half-series that can be counted containing twelve stigmata. The form of the atrial siphon, though varying according to the degree of contraction, is not against this conclusion. The Barrier Reef and Cape Boileau specimens have more numerous stigmata (14–18 in a half-row). There are 7 or 8 longitudinal muscle-bundles and more than 30 transverse bands.

Herdman (1899, pp. 85–89) records eight species of *Psammaplidium* from Australia. Five of these species have not been available for examination, but appear to belong to the Polyclinidae. The other three are *P. ovatum*, *P. spongiforme* and *P. pyriforme*. The accuracy of Herdman's description of *P. spongiforme* has been confirmed by examination



Text-fig. 7.—a, b, c, Type-specimen of *Eudistoma ovatum* (Herdman). a, Thorax. b, Tip of abdomen. Total length of abdomen 8 mm. c, Branchial and atrial siphons. d, Zooid from type-specimen of *Eudistoma pyriforme* (Herdman). Middle part omitted. Total length of zooid 6 mm. *s.*, stomach. *tw.*, twist in intestine.

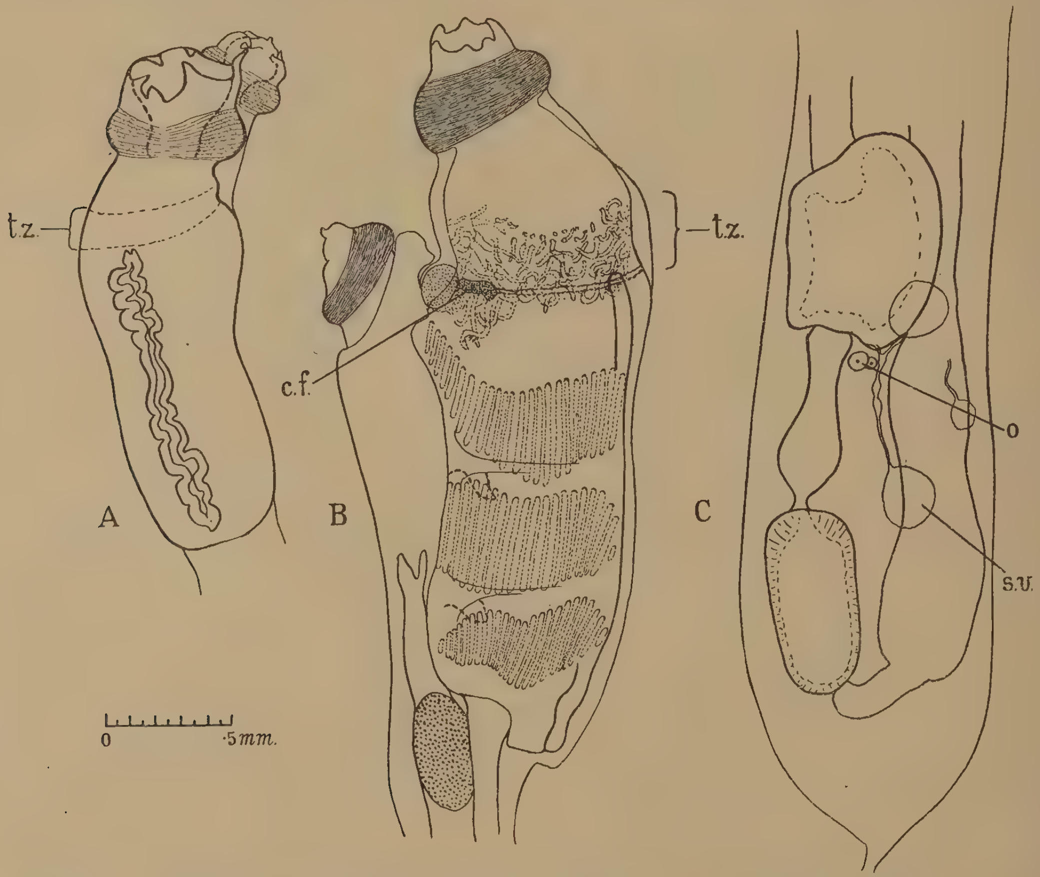
of the type (B.M. 87.2.4.382). According to his definition of the genera of Polyclinidae, Hartmeyer (1909, p. 1464) justly included this species in *Macroclinum*. Examination of the type of *P. pyriforme* (B.M. 87.2.4.482) shows that it is a *Eudistoma*, closely allied to



TEXT-FIG. 8.—*Eudistoma ovatum* (Herdman). A and B, Thorax of two zooids from one colony from Cape Boileau. Musculature omitted. C, Outline of colony from Barrier Reef. *c.f.*, ciliated funnel. *t.z.*, tentacular zone.

E. ovatum. The colonies are smaller and, owing to the more numerous sand-grains in the test, harder than those of *E. ovatum.* The broad distal end is flattened and wrinkled. The zooids adhere more closely to the test than in *E. ovatum.* They are not numerous and are much contracted. The one figured (Text-fig. 7 D) is 6 mm. long. The siphons appear rather more muscular than those of *E. ovatum* without having a definite sphincter. There are very numerous transverse muscle-bands on the thorax (about 60, but accurate counting is impossible), and 7 (or 8 ?) longitudinal bundles of varying thickness. The thick-walled oval section of the intestine is rather more sharply defined than in *E. ovatum.*

Another Australian *Eudistoma* of the *Psammaplidium* type appears to be identical with *Polycitor* (*Eudistoma*) *angolanus* Michaelsen (1915, p. 452) = *P. paesslerioides* var. *angolanus* Michaelsen (1914, p. 430) from W. Africa. A colony of this species from Cape Boileau (B.M. 30.9.23.20), which has had a piece cut off, must have been roughly hemispherical when complete. It is 8 cm. in diameter and 3·5 cm. deep at the centre. It was attached by the central area of the more or less flat basal surface. The foreign particles in the test are less numerous in the upper regions than they are in *E. ovatum*, and there are granules of almost black pigment here and there, but not in sufficient quantity to affect the colour of the colony as a whole. A well-expanded zooid, dissected unbroken from the colony, is 13 mm. long, exclusive of the thread-like continuation of the abdomen,



Text-fig. 9.—*Eudistoma angolanum* Michaelsen. From Cape Boileau, N.W. Australia. A, Contracted thorax. B and C, Thorax and abdomen of expanded zooid from the same colony. Total length of zooid, 13 mm. Musculature, except sphincters, omitted. (For explanation of lettering, see footnote, p. 73.)

but the majority are less owing to immaturity or contraction. The very thick band of muscle round each siphon (Text-fig. 9 A, B) is sharply defined, and produces a convexity both inside and outside the siphon. It is not completely circular, being interrupted on the outside, *i. e.* at the point furthest from the other siphon. The atrial siphon may appear longer or shorter than the branchial siphon. The tentacles are numerous and arranged in several rows. As in *E. ovatum* the ciliated funnel forms a conspicuous projection below the central nervous system (Text-figs. 8 A, 9 B, *c.f.*). The stomach is smooth and more or less round. The first part of the intestine is wider posteriorly and is separated by a deep constriction from the second part, which is oval, thick-walled and very clearly defined (Text-fig. 9 C). The next section begins very narrow, widens rather suddenly and narrows very gradually for the rest of its length. The regions of the intestine of *E. ovatum* correspond to these, but are much less sharply defined (Text-fig. 7 A). Another peculiarity of this specimen is the presence of stalked, membranous vesicles beside the intestinal loop (Text-fig. 9 C, *s.v.*). Possibly they are empty testis follicles.

Michaelsen divided *E. angolanum* into two varieties. In its sphincter muscles and the number of longitudinal muscles the Australian form resembles var. *togoense,* but instead of 80, less than 60 transverse muscle-bundles were counted.

The Cape Boileau specimen of *E. angolanum* is clearly identical with the form from N.W. Australia identified by Hartmeyer (1919, p. 105) with *Polycitor amplus* Sluiter (1909, p. 21). Zooids from the same colony as those figured here (Text-fig. 9) resemble Hartmeyer's fig. 54 in the narrowness of the siphons below the sphincter. The appearance of a longitudinal fold on the stomach shown in Hartmeyer's fig. 55 is seen in some zooids, but this is not structural, for sections and well-expanded zooids show that the stomach is smooth, as was recognized by Hartmeyer. Sluiter's figure does not show either of the chief peculiarities of this species, namely the conspicuous muscle-bands on the siphons and the sharply-defined oval section of the intestine, and it seems possible that the Australian form is distinct from *E. amplum.*

There are thus three Australian sandy species of *Eudistoma* known, of which *E. ovatum* and *E. angolanum* are distinguished by the form of the siphons, the intestine and the colony, and the third species, *E. pyriforme,* is in some ways intermediate, but is only known from the rather poor type-specimen, consisting of half of one colony and some small fragments. The differences in size seen in the accompanying figures of these species are not constant, and depend very much on the degree of contraction.

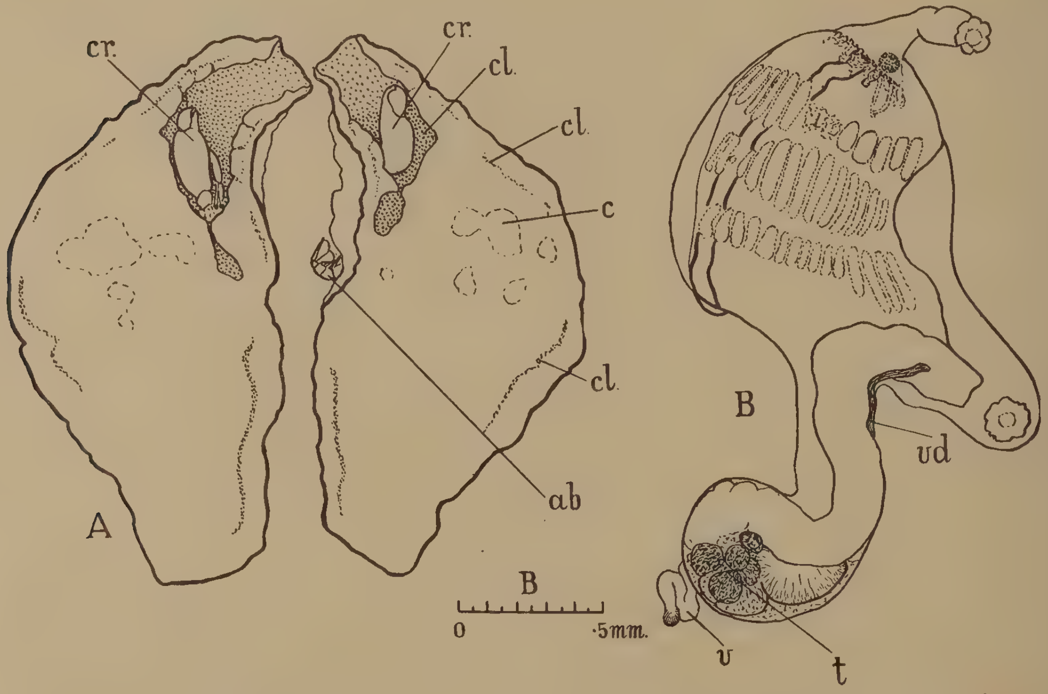
Sigillina deerrata (Sluiter). (Text-fig. 10 A, B.)

Distoma deerratum Sluiter, 1895, p. 167, pl. vi, figs. 5–7.
Polycitor coalitus Sluiter, 1909, p. 23, pl. ii, fig. 4, pl. vi, fig. 1.
Sigillina (*Polycitor*) *coalita* Michaelsen, 1930, p. 484.

DISTRIBUTION.—Torres Strait, Malaya (Siboga St. 164).

OCCURRENCE.—St. XVII (3 colonies).

These colonies are all more or less egg-shaped, with a large cloacal orifice at one end (Text-fig. 10 A) and a few scraps of calcareous alga adhering at the other. The largest is 7 cm. high and 5 cm. in diameter at the widest part. The other two are a good deal smaller. The cloacal aperture has a thin vertical rim. The colonies are a pinkish-brown colour. The zooids are arranged in systems of irregular size and shape, with smaller zooids at the centre and larger towards the outside. The systems are most numerous at the anterior end and are absent from the posterior end. The systems have no cloacal opening to the outside. Their central cavity opens into the cloacal canal, which occupies a layer a little below the surface of the colony, and completely below the zooids. Many of the zooids do not communicate with the common cloaca of their system, their atrial siphon opening into a channel of the test passing directly to the cloacal canal. The centre of the colony consists of firm, but gelatinous test, with a few cavities in its anterior part (Text-fig. 10 A, *c.*). In the smaller colonies this central column extends to the cloacal aperture, forming a sort of plug. In the large colony there is a larger space occupied by the claws of two Decapod Crustaceans. These commensals lie in the cloacal canal at diametrically opposite points. They each have one very large claw, which is extended towards and very nearly reaches the cloacal aperture (Text-fig. 10 A, *cr.*). One of the smaller colonies contains a similar but smaller Crustacean, in a more posterior portion of the cloacal canal. The absence of the plug in the cloacal aperture of the large specimen is probably due to the presence of the Crustacea.



TEXT-FIG. 10.—*Sigillina deerrata* (Sluiter). A, Large colony cut in half, showing Crustacea in the cloacal canals. B, Zooid from one of the small colonies. (For explanation of lettering, see footnote, p. 73.)

The central column contains calcareous crystals of various form. In the large colony they are linear and arranged in a feathery formation. In the smaller colonies similar elongate crystals are attached to short thick rods.

A zooid is shown in Text-fig. 10 B. The stigmata may be much less irregular than in the one figured. There is a fairly regular network of fine longitudinal and transverse muscles on the thorax. The vascular process varies very much in length.

I have examined the type-specimens of *Distoma deerratum* Sluiter and *Polycitor coalitus* Sluiter, and have satisfied myself that they are synonymous and that the present specimens belong to the same species. The form of the colony is the same in all. The two type-specimens appear to have been somewhat crushed in preservation, giving them the tongue-like shape described by Sluiter. They both have a large terminal cloacal aperture, plugged by the central column of the test. *P. coalitus* has feathery crystals like those of the large Barrier Reef specimen. The wavy-edged stigmata, mentioned by Sluiter in *D. deerratum*, are characteristic of all the specimens. The irregular fourth row of stigmata described in the same species has not been seen. The length of the vascular processes and branchial siphons is extremely variable in all specimens.

From Sluiter's description *D. deerratum* appears to differ from *P. coalitus* in the number of stigmata in a row, the presence of papillae in the branchial siphon and the form of the alimentary canal. Adult zooids of *D. deerratum* have, however, as many stigmata as those of *P. coalitus*, the structure of the alimentary canal is essentially the same and no trace of papillae can be found in the branchial siphon, though in an oblique view the tentacles may give such an impression.

The generic position of this species is obscure. The method of budding, the vascular process (or epicardial post-abdomen), the lobed atrial orifice and the musculature of the thorax clearly show its affinities with *Polycitor*, as was recognized by Sluiter. The cloacal system with a single large cloacal aperture at the apex of the colony and the zooids with long, backwardly curved atrial siphon and small round abdomen afford an interesting parallel with *Didemnopsis*.

In classifying the species of *Polycitor*, Michaelsen (1930, p. 479) regards the number of rows of stigmata as important and reserves *Polycitor* for species with more than three rows. He uses *Sigillina* as a wide genus to cover all the species with three rows pending their re-classification, and defines a number of subgenera of this genus. The cloacal system of *S. deerrata* excludes it from all these subgenera.

Trididemnum cyclops Michaelsen. (Plate II, fig. B; Text-fig. 11.)

Trididemnum cyclops Michaelsen, 1921*a*, p. 19, pl. i, fig. 10.
? *Trididemnum planum* Sluiter, 1909, p. 42, pl. iii, fig. 12, pl. vii, fig. 7; Michaelsen, 1920, p. 6.

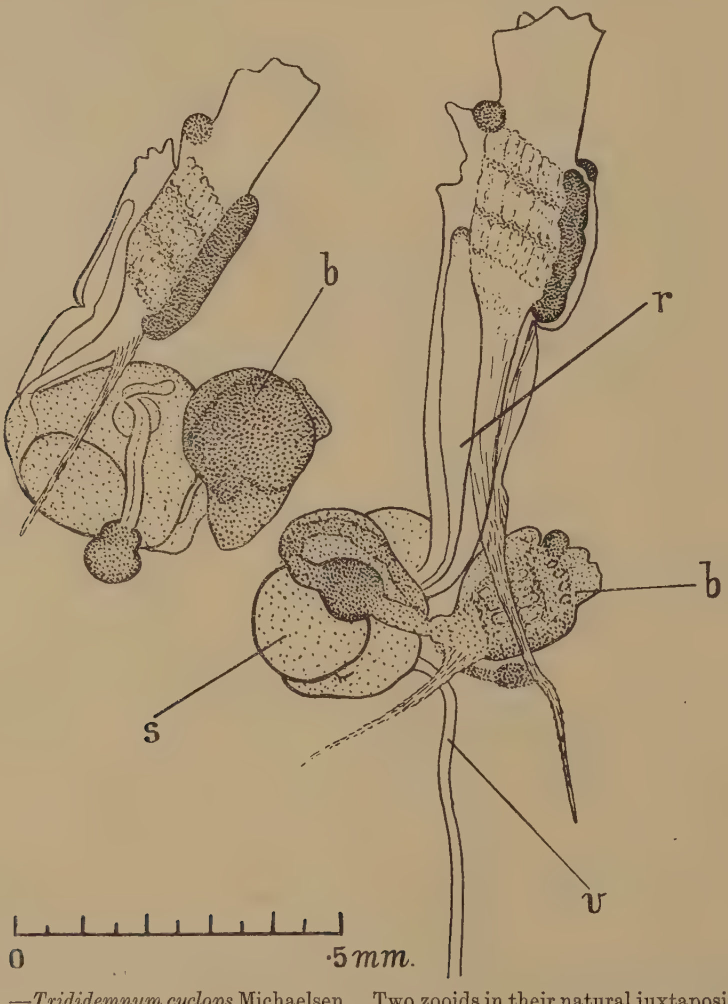
Distribution.—Malaya ? Madagascar.

Occurrence.—G. 3.

The colonies are thicker than Michaelsen's, being ·2–·3 mm. thick and having a cushion-like appearance. They are pale buff with white edges of very variable width. They agree in the distribution of spicules, excretory granules and bladder-cells and in the presence of numerous spherical bodies in the cloacal canals. Dr. C. M. Yonge finds that these bodies are zooxanthellae. The spicules are larger than described by Michaelsen. There is very little pigmentation, even the black cap on the endostyle being very rarely present. The zooids are similar in general form. The branchial siphon is longer and thicker and its dorsal lobe tends to project. The atrial siphon is usually as described by

Michaelsen, but in some (young ?) zooids it is more anterior, tubular and lobed (Text-fig. 11, smaller zooid).

The cloacal canals and the thoracic portions of the zooids occupy the region between the two layers of spicules, and in a hand-section such as that figured (Plate II, fig. B) the zooxanthellae (*z.*) can be seen to be massed in great numbers in this region. They are not found elsewhere. Dr. Yonge finds that they are not of the same kind as those in *Diplosoma virens*.



Text-fig. 11.—*Trididemnum cyclops* Michaelsen. Two zooids in their natural juxtaposition. (For explanation of lettering, see footnote, p. 73.)

T. cyclops may prove to be synonymous with *T. planum* Sluiter, which resembles it in many ways. Spicules and bladder-cells are similarly distributed. The spicules resemble those of the Barrier Reef specimens in size. The atrial siphon is longer and unlobed. The zooxanthellae are not mentioned unless, as seems possible, they are referred to as pigment-cells.

Trididemnum savignii (Herdman).

Didemnum savignii Herdman, 1886, p. 261, pl. xxxiv, figs. 1–5.
Trididemnum savignii Van Name, 1921, p. 314, text-figs. 7–9 (synonymy); 1924, p. 25; Sluiter, 1927, p. 89.
? *Didemnum areolatum* Herdman, 1906, p. 337, pl. viii, figs. 26, 27.

Distribution.—Indian Ocean, Morocco, W. Indies.

Occurrence.—St. XIX (1 colony).

This colony forms an irregular incrustation measuring 5·5 by 2 cm. and 1–2 mm. thick. It is a dirty, rather speckled, grey colour, owing to the irregular distribution of the spicules in the upper layers of the test, the yellowish-brown colour of the zooids and the grey of the test. There is a narrow grey border free from zooids and spicules. The cloacal apertures are round and shallow and 2–3 mm. in diameter. They are conspicuous owing to the narrow black rim of their orifice, and to a dense layer of spicules in the floor of the cloacal canal showing through the opening. The test consists of three layers. The layer above the cloacal canals contains scattered spicules in dense clumps and singly. The clumps do not coincide with the branchial apertures. Below the cloacal canals, forming their floor, is a thin layer of very closely placed spicules. This layer is at the level of the neck of the zooids. Below this spicules are extremely rare and the test is packed with bladder cells. The spicules resemble those figured by Van Name. The largest are ·08 mm. in diameter. Besides the black pigment in the rim of the cloacal orifice, there is pigment in the test in the interstices of the bladder-cells and in the mantle on thorax and abdomen.

The branchial and atrial siphons are short and lobed. The thorax is smaller than the abdomen. The neck is narrow, but not very long, and the abdomen is turned sideways. The retractor is about as long as the abdomen. Owing to pigmentation the details of the internal structure cannot readily be made out. There are three rows of stigmata. The stomach is long and oval with cardiac and pyloric inpushings. No reproductive organs were seen.

Examination of the type of *Didemnum areolatum* Herdman (B.M. 07.8.30.36) shows that it agrees with the present specimen in the shape, size and distribution of the spicules, except that the largest are even larger. It differs in pigmentation; the general colour is a yellowish brown, due to brown pigment-granules which are scattered in the test below the spicule layer, and are concentrated above the spicules in the floor of the cloacal canals. The zooids are also yellowish brown in colour, with some brown pigment on the branchial siphon and the thoracic tubercles. The blackish pigment of the Barrier Reef specimen is absent. The cloacal apertures are visible. The retractor is rather short. These differences are slight in themselves and fall well within the range of variation attributed to *T. savignii*, with which I think *D. areolatum* is synonymous. Herdman's figures are misleading, giving no indication of the arrangement of the spicules in a dense layer below the cloacal canals, nor that the bladder-cells are closely packed throughout the part below the spicule layer, although both of these are characteristic features of the type-specimen. A good deal is made of the arrangement of the zooids in systems. This effect is much less definite than fig. 26 would suggest, and in basal view, where the zooids are much more distinctly visible, they can be seen arranged in sinuous lines. The testis is a single follicle round which the vas deferens makes about eight turns.

In the pigmentation of the zooids and particularly of the cloacal apertures, the Barrier Reef specimen of *T. savignii* resembles the encrusting specimen of *Didemnum ramosum* Sluiter (1909, p. 63) from Sailus Ketjil, which, however, had 4 rows of stigmata.

Trididemnum natalense Michaelsen.

Trididemnum natalense Michaelsen, 1920, p. 3, text-fig. 1.

Distribution.—Natal.

Occurrence.—St. XIX (1 colony).

This colony agrees with *Trididemnum natalense* Mich. except in the distribution of the spicules, which are irregularly scattered in small clumps and form no continuous layer. The branchial sac usually agrees with Michaelsen's figure, but occasionally the stigmata are considerably longer. Only female reproductive organs were seen. Michaelsen found male gonads only.

Van Name (1921, p. 314) gave this as a doubtful synonym of *T. savignii.* As it is distinguished by the distribution of spicules and pigment from the specimen of *T. savignii* from the same locality on the Barrier Reef, it has seemed best to treat it as distinct for the present.

Leptoclinides reticulatus (Sluiter).

Didemnum reticulatum Sluiter, 1909, p. 60.
Leptoclinides sparsus Michaelsen, 1924, p. 336, text-fig. 13.

Distribution.—New Zealand, Malaya (Siboga, St. 37).

Occurrence.—St. XII (1 colony).

It is surprising to find, on examining the type, that *D. reticulatum* is a *Leptoclinides.* The zooids are of the characteristic form with a backwardly-directed atrial siphon opening into cloacal canals that run below the zooids, rather conspicuous longitudinal musculature on the thorax and the characteristic thoracic tubercles. Mature gonads were not seen, but the testis appears to be divided. The test has a layer of bladder-cells at the surface. Below this is a zone containing spicules, which are most numerous in its upper part. This zone has irregular spindle-shaped or branched pigment-cells. The pigment-cells are chiefly congregated just below the bladder-cell layer, but are found here and there lower down. Below the spicule-zone the test consists almost entirely of bladder-cells, but a few spicules are found in this part, especially at the basal surface. The zooids and cloacal canals occupy the spicule zone. The spicules are, on the average, ·03 mm. in diameter, and may attain ·04 mm. Thus neither the spicules nor the pigment-cells of the specimen from St. 37, which is regarded as the type, agree perfectly with Sluiter's description, and one can only assume that some of the specimens from other localities were different.

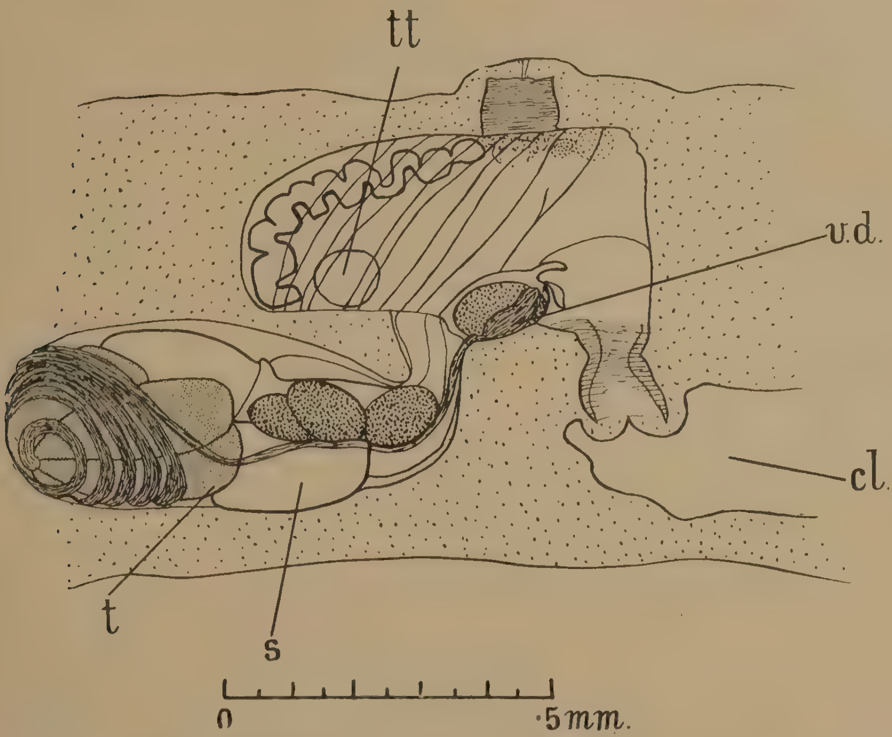
The Barrier Reef specimen differs from the type in the greater quantity of pigment, pigment-cells being found throughout the bladder-cell and spicule layers. This gives the whole colony a darker appearance, the borders being dark grey and the central parts speckled grey and black. In the type the central parts may be grey and black, or white and black, but the borders are always white. No cloacal openings were seen in the Barrier Reef specimen. They are rather conspicuous in the type, being round or oval with a thin border free from spicules and pigment-cells. In the preserved material this border forms a frilled edge to the aperture, but it looks as if it would stand up as a collar in the living animal.

The agreement of this species with Michaelsen's full description of *L. sparsus* leaves me with no doubt that he had the same species.

Leptoclinides lissus sp. n. (Text-fig. 12.)

Occurrence.—St. XVI (1 colony).

This specimen forms a band 3 cm. wide round a worm-tube. It is less than 1 mm. thick, except at a few points where it attains 2 mm. It is smooth, white and opaque.



Text-fig. 12.—One zooid of *Leptoclinides lissus* sp. n. (For explanation of lettering, see footnote, p. 73.)

The zooids are visible to the naked eye as light grey patches. Under considerable magnification the branchial orifices of decalcified and stained pieces can be seen to have lobes of very unequal size, as figured for *L. diemenensis* (Michaelsen, 1924, p. 331), but in a surface view of the undecalcified colony the conspicuous features are three groups of two or three spicules surrounded by a muscular ring. Bladder-cells are rare and do not form a definite layer. The spicules are mostly about ·04–·05 mm. in diameter, regularly stellate with pointed rays. They are rather numerous throughout the zone occupied by the zooids, but are rare in the basal layer. They are very evenly and closely distributed in the surface layer. The abdomen turns sharply sideways (Text-fig. 12), and the atrial siphon is directed downwards to the cloacal canal which runs near the base of the colony. The siphons are both long, the length varying somewhat, apparently according to the degree of contraction. No vascular processes were seen. The thoracic tubercles are of the form characteristic of *Leptoclinides*. They are ·1 -·2 mm. in diameter, and lie near the middle of the posterior end of the thorax. There are about 9 longitudinal muscle-bands on each side of the thorax. The branchial sac has 4 rows of long, oval stigmata and about 12 stigmata in a row. There are about 16 tentacles. As many as 7 testis follicles have been counted and the vas deferens makes 6 turns.

Remarks.—This species belongs to the southern group of species of *Leptoclinides*, differing from the northern *L. faeröensis* Bjerkan in their divided testis. It is very closely allied to *L. diemenensis* Michaelsen (1924, p. 331), only differing in the smoothness, whiteness and opacity of the colony and in the absence of an outer layer of bladder-cells. Probably when more is known of their range of variation these species will be found to be synonymous; at present it seems best to treat them as distinct.

Didemnum candidum Savigny. (Plate II, fig. A; Text-fig. 13.)

Didemnum candidum Savigny, 1816, pp. 14, 194, pl. iv, fig. 3, pl. xx, fig. 1; Hartmeyer, 1915, p. 419, text-figs. 13, 14; Michaelsen, 1919, p. 18; Van Name, 1921, p. 322, figs. 16–18, 20–25; Michaelsen, 1924, p. 358 (synonymy); Van Name, 1924, p. 25.

DISTRIBUTION.—New Zealand, Indian Ocean, Atlantic.

OCCURRENCE.—Low Isles: Thalamita Flat (pink and white forms), R.C. (pink form), Dredge: St. XIX, XXI, XXII.

Two characteristic specimens of *Didemnum candidum* were dredged growing on a sponge at St. XXI and very small colonies on other Tunicates at St. XIX and XXII. The spicules are stellate and are slightly more numerous in the upper layers. The largest colony is irregular in shape. It measures 5 cm. × 1·5 cm., and is about 1·5 mm. thick. They are all white.

The shore Didemnids of similar type have burr-like spicules with numerous fine rays, such as were found by Van Name (1921) in *D. candidum*. The collector, who was an experienced systematist, found that they were of two clearly defined kinds, differing, among other things, in colour, one kind being white, the other pink. He describes the white colonies as being "generally larger and more winding," and differing in texture. He says that the colours of both were quite constant and did not suggest colour varieties.

In the preserved material the white form is thin. It has fewer spicules in the lower layers. There is a darkly pigmented epithelium over the abdomen and some pigment on the thorax. The cloacal apertures are small and inconspicuous, and in section a few large bladder-cells are seen at the surface. The pink colonies from the Thalamita Flat are small and cushion-like (Plate II, fig. A). The colour is lodged in the test, which is pink, and in the zooids, which are red. The cloacal apertures are rather large and shallow. The specimens of the pink type from R.C. are, however, intermediate. The colonies are thin and white, when preserved, as in the white form, but the spicules are densely distributed throughout as in the pink. The cloacal apertures are slit-like.

No essential difference could be detected in the zooids of any of these colonies. The branchial siphon is broader than high, with six shallow, pointed lobes. The thorax is about as wide as high with a simple atrial opening. The thoracic tubercle is external and lies at about the level of the third row of stigmata. The branchial sac has four rows of stigmata, and about eight stigmata in a row. There is a pointed retractor which is not attached to the neck. The œsophagus is sharply constricted at about the middle of the neck. The abdomen is slightly larger than the thorax. There is a more or less oval stomach. The intestine is in three sections, separated by constrictions. The first (" nachmagen ") is cylindrical, with a sudden expansion behind. The second (" drusenmagen ") is oval and the third long and slightly tapering. The rectum is thin-walled. The ovary and testis lie beside the intestine. The testis consists of a single follicle, round which the vas deferens makes five turns.

Such differences in the zooids as exist appear to depend either on the thickness of the colony or on the state of contraction of the digestive tube. In thin colonies the abdomen is turned sharply to one side, while in thick ones it hangs straight down. The stomach may have both cardiac and pyloric inpushings, or one only, or neither, and the parts of the intestine may be wide or narrow. These differences may appear in the same colony (Text-fig. 13). In the zooids from the pink form the thoracic tubercles are slightly more conspicuous and more stalked than in the other specimens, but the whole thorax is less shrivelled, so the difference is probably only apparent.

Superficially, the pink form might be thought to be *L. densum* Nott (1892, p. 311). This species differs, however, in the spicules, whose rays are few and very blunt, in the longer branchial siphon and in the divided testis. Michaelsen (1924, p. 354) re-discovered Nott's species and confirmed these characteristics. He regards *D. densum* as synonymous with *D. albidum* (Verrill, 1871, p. 446).

To sum up, the shore specimens attributed to *D. candidum* all differ from the dredged specimens in their burr-like spicules. When alive they fell into two groups, distinguished by colour, texture, etc., but the only character which constantly distinguishes these same groups in preserved material is the distribution of spicules. These are less numerous in the lower layers of the white group and uniformly dense throughout in the pink. The zooids are very similar in all. They all fall within the range of variation attributed to *D. candidum* by Van Name (1921), and Michaelsen (1924) expresses his agreement with Van Name's view. On the other hand, a species (*D. densum*), somewhat resembling the pink form externally, differs in internal structure.

At present, therefore, there seems to be no alternative but to treat all the Barrier Reef specimens as one species. The observations on the living material are, however, of great importance, and point to the existence of differences which are not expressed by the present systematic treatment of the Didemnidae.

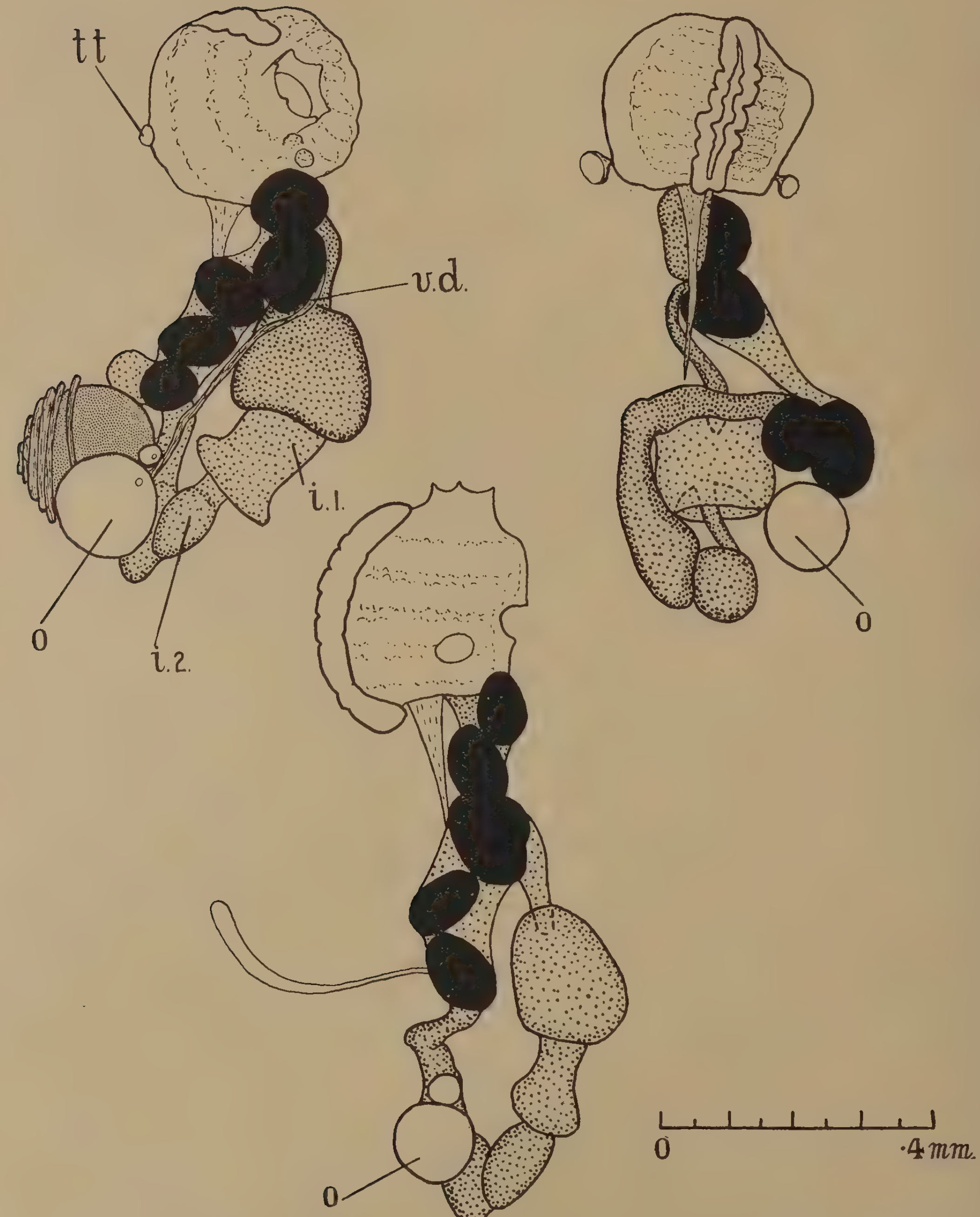
Didemnum psamathodes var. *skeati* (Sollas).

Hypurgon skeati Sollas, 1903, p. 729, pls. xxxiv, xxxv.
Didemnum psammatodes var. *skeati* Michaelsen, 1920, pp. 22, 27 (synonymy).

Distribution.—Malaya, Indian Ocean, Gold Coast ?

Occurrence.—Thalamita Flat.

These specimens correspond to Sollas' description of var. *skeati*. They differ from the typical form of Sluiter (1895, p. 171) in having a cluster of spicules round each branchial opening, and few, if any, in the rest of the test.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TEXT-FIG. 13.—*Didemnum candidum* Savigny (pink form). Three zooids from the same colony. (For explanation of lettering, see footnote, p. 73.)

Didemnum voeltzkowi Michaelsen.

Didemnum voeltzkowi Michaelsen, 1920, p. 54, text-fig. 6.

Distribution.—Madagascar.

Occurrence.—Sand Flat, A4.

These specimens agree in most points with Michaelsen's description of *D. voeltzkowi*. The spicules are uniformly and densely distributed except in the region of the lowest cloacal canals, where they may be slightly less numerous. No central cavity was seen in them. The colonies from A4 are encrusting. Those from the Sand Flat are rather large irregular pieces with a smooth white basal surface which appears only to have been attached here and there. The largest measures 60 mm. × 30 mm. The zooids are very well expanded and are 1·5 mm. long. The branchial aperture is not lobed. The anus is beside the posterior end of the thorax. Otherwise their agreement with Michaelsen's description is exact.

The spherical bodies described by Michaelsen are very numerous round the branchial sac. Dr. C. M. Yonge finds that they are zooxanthellae. The general arrangement is that shown by Michaelsen (1920, p. 52, Text-fig. 5) in *D. bistratum*, but the zooxanthellae tend to be arranged in a single layer on the surface of the branchial sac and its projecting laminae, and they may be so numerous as to fill the rectangular spaces formed by these laminae as seen in cross-section. Dr. Yonge finds that the zooxanthellae are not of the same kind as those in *Diplosoma virens*.

D. voeltzkowi was found at Madagascar. Two species (*L. bistratum* Sluiter, 1905, p. 18, and *D. patella* Gottschaldt, 1898, p. 651) of the *D. bistratum*-group of Michaelsen (1920) are known from Malaya, but they do not agree with the Australian specimens as closely as does *D. voeltzkowi*.

D. voeltzkowi superficially resembles *Leptoclinum tonga* Herdman (1886, p. 269), from Tongatabu. They agree in the shape of the colony, the absence of bladder-cells and the distribution of spicules, in the long thorax with four rows of long stigmata and the relatively short round abdomen, and in the position of the thoracic tubercles. Examination of Herdman's type shows that they differ in many ways. In *L. tonga* the surface of the colony is smooth. There are no cloacal canals below the zooids. The spicules have fewer longer rays (Herdman, pl. xxxv, fig. 4). Each zooid has a very long retractor, extending beyond the abdomen for more than the length of the whole zooid. The zooids are much less numerous. The atrial opening is not remarkably extensive, and there are no zooxanthellæ. The testis is slightly lobed, and the vas deferens makes five turns round it.

Didemnum chartaceum Sluiter. (Text-fig. 14 a, b.)

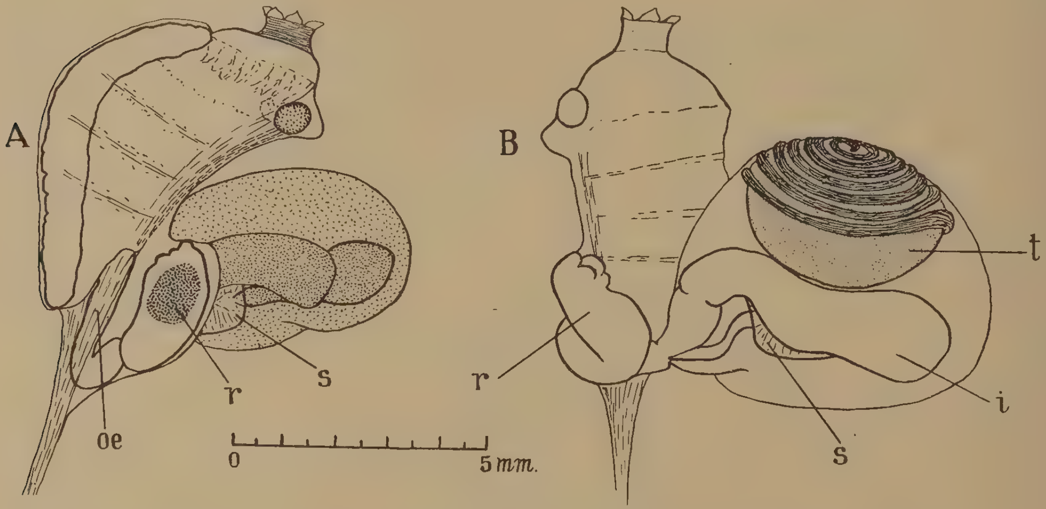
Didemnum chartaceum Sluiter, 1909, p. 57.

Distribution.—Flores (Siboga, St. 50).

Occurrence.—St. XVI (1 colony).

This colony covers the back of a small Dromiid crab, only leaving the ventral surface and appendages free. It is 2·5 mm. thick at the thickest point. The zooids are evenly distributed and show as darker patches on the surface. There are three shallow, round cloacal apertures, conspicuous owing to the absence of spicules in their floor. The surface layer consists of bladder-cells. Below this there is a thin layer of closely placed spicules. The main thickness of the test consists of bladder-cells and the basal layer contains some spicules, but they are not so thickly distributed as in the upper spicule layer. The spicules have rather numerous blunt rays and the majority are ·03 mm. in diameter.

The zooids occupy the upper half of the colony, but their retractors extend straight down into the lower half and may nearly reach the base. There are knobbed vascular processes. The abdomen is slightly larger than the thorax and placed at right angles to it. The branchial siphon is about as wide as high and has six small pointed lobes. The atrial opening is a simple hole. The thorax has longitudinal muscle-bands, the strongest of which are dorsal, and there are transverse muscles over the transverse bars. There are four rows of stigmata. The dorsal languets are large. The thoracic tubercles contain large quantities of spicules and are very conspicuous in undecalcified material. They occupy the middle of each side of the thorax and project outwards. The testis consists of one large follicle, round which the vas deferens makes eight turns. It lies beside the intestinal loop.



Text-fig. 14.—*Didemnum chartaceum* Sluiter. Two views of zooids from the type-specimen. A, Seen from the left. Abdomen shaded. B, Composite drawing of a zooid seen from the right. (For explanation of lettering, see footnote, p. 73.)

Examination of the type of *D. chartaceum* (Text-fig. 14 A, B) shows that it agrees very closely with this specimen. It differs in the form of the colony, which in the Barrier Reef specimen is clearly related to its position on the back of a crab. No vascular processes were seen in the type, and it differs in colour. The tissues of the Barrier Reef colony are of a reddish-purple colour, of such persistence and intensity that unstained microscopic preparations have all the appearance of having been stained. It does not look like a natural pigmentation, for it is diffused through all the tissues both of zooids and test.

The crab and some sponges from the same bottle are the same colour, and the original label is somewhat stained. All these points lead me to suspect that the colour is derived from some other organism bottled with them.

Didemnum jedanense Sluiter.

Didemnum jedanensis, Sluiter, 1909, p. 59.

DISTRIBUTION.—Malaya.

OCCURRENCE.—St. XII (1 colony on a Gastropod), XIX (1 colony on weed).

I have examined original material of this species from three of the four stations at which it was obtained. All agree in having a surface layer of bladder-cells without spicules, and below this a zone with spicules, the spicules becoming less numerous basally where there are many bladder-cells. They all have pigment-cells in the upper layers, giving a streaked or mottled appearance to the colony as a whole. The pigment is purplish brown in spirit. The cloacal system is chiefly at the level of the thorax, but has channels extending between and below the zooids. The zooids have a rather large abdomen and a long retractor, extending beyond the end of the abdomen. The thorax has musculature on the transverse bars, a pair of strong longitudinal muscle-bundles on the dorsal edge, and fine longitudinal strands over the rest.

In other ways there is a certain amount of difference between the specimens. The specimen from St. 303 shows certain peculiarities which I interpret as signs of old age in the colony. The vas deferens appears to be degenerating. It is inflated and composed of rather coarse, deeply-staining tissue, and only forms one turn. No trace of the testis can be seen. The test contains excretory granules and fæcal pellets in its lower layers and much pigment throughout. There are very few zooids and the cloacal system is of correspondingly small extent. The spicules are large with many blunt rays.

The specimens from the other two localities are therefore more important representatives of the species and I choose that from St. 89, the first on Sluiter's list, as the type. It differs from that from St. 273 in its rather smaller spicules with more numerous, finer rays. The spicules from St. 273 are larger, some being as much as ·03 mm. in diameter, and very regularly stellate. In the type the pigment-cells are elongate and distributed throughout the zooid-containing region of the test. In the specimen from St. 273 they are more or less round and only found in the bladder-cell layer. The zooids are visible as grey dots at the surface of the colony from St. 273, and are less conspicuous in the type. Some zooids in the type are well expanded and the thorax then appears considerably longer than broad, with large stigmata. More contracted zooids do not differ noticeably from those from other specimens. The vas deferens makes 6–8 turns round the testis, which may be flat or spherical in different zooids of the same colony. Vascular processes with knobbed ends have been seen in the type, but not in the specimen from St. 273.

Two specimens from the Barrier Reef agree with these specimens in the presence of pigment-cells, the distribution of bladder-cells and spicules, the tridimensional cloacal system, the general form of the zooids, the long retractor and the musculature of the thorax. One (St. XII) resembles the type in its inconspicuous zooids. The other, like that from St. 273, has zooids clearly visible as dots on the surface. This specimen has large spherical pigment-cells, ·05 mm. in diameter, with the pigment-granules arranged peripherally. They appear distinctive, but the other specimen shows gradations between these and the smaller, less regular ones of the specimen from St. 273. The spicules are rather smaller than those of any of the original specimens. A few are ·025 mm. in diameter, but most are smaller. They have rather numerous fine rays. Knobbed vascular processes are present in the specimen from St. XIX, but have not been seen in that from St. XII. The differences, both here and in the types, in the occurrence of vascular processes may depend on the part of the colony cut, as they were only seen at the edge. No gonads were seen.

This species as understood by Sluiter has a considerable range of variation which covers the characteristics of the Barrier Reef specimens, and it has seemed best to identify them with it for the present.

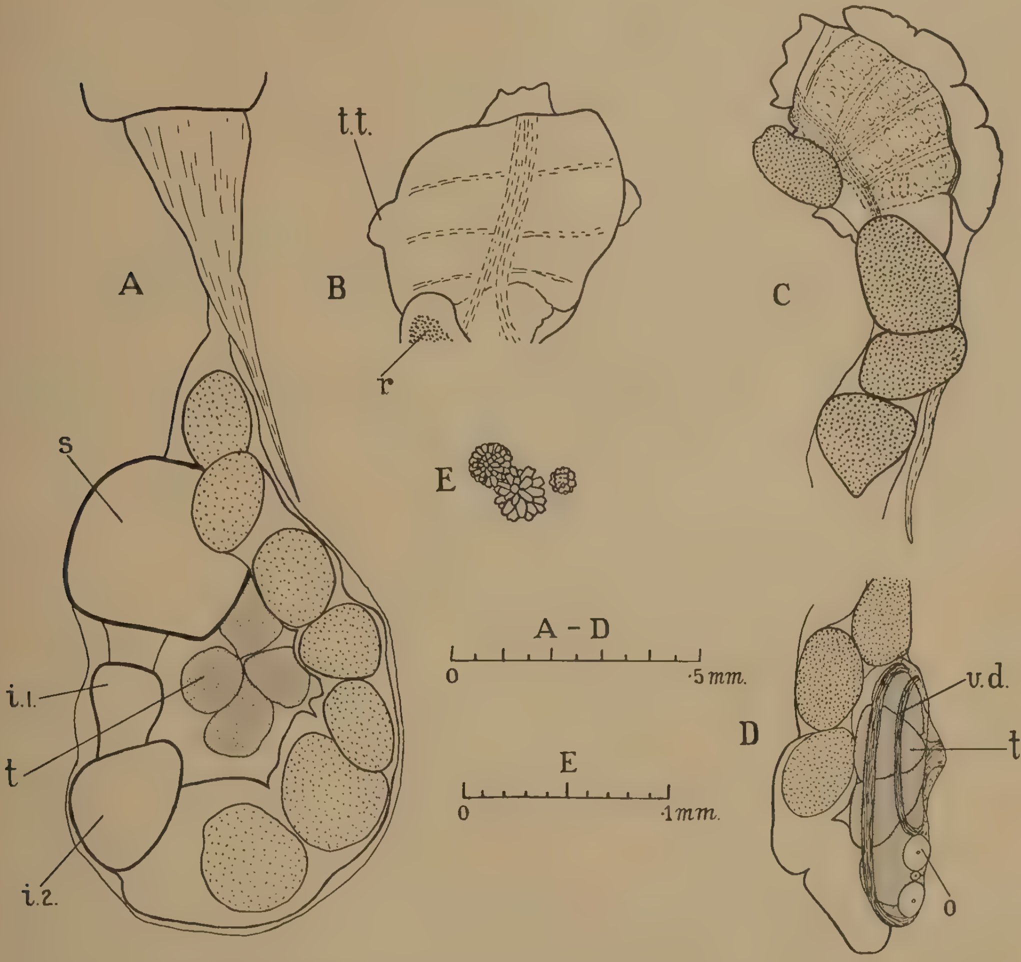
Didemnum (*Polysyncraton*) *magnetae* sp. n. (Text-fig. 15).

OCCURRENCE.—St. XXIII (1 colony).

The colony appears to have been loosely attached to an irregular substratum. It is on the average, 3 mm. thick, and of flexible, leathery consistency. The zooids are yellowish grey. They are arranged in double rows, which form a network over the surface of the colony, conspicuous to the naked eye. The surface areas between the rows of zooids contain many spicules and are white and slightly prominent. There are two conical projections of the surface of the colony, each with a rather large, round aperture at the summit. One contains a tube of fine mud which was presumably made by some commensal animal, but is now empty. The other contains shell fragments, etc. The hollow centres of these cones are traversed by strands of test containing scattered spicules. No other cloacal apertures were seen.

In vertical section the thin layer of test above the cloacal canals is seen to contain spicules and bladder-cells in quantities varying according to the region cut. In some parts there is a definite layer of spicules here. Below the cloacal canals, and forming their floor, is a thin layer of densely packed bladder-cells, free from spicules. Spicules are most densely packed just below this layer. They become rather less numerous towards the basal surface and some bladder-cells are found. There is a thin basal layer with many spicules, giving a smooth, white under-surface. No pigment-cells have been seen. There are clusters of excretory granules in the lower layers, and in many parts of the test faecal pellets are very numerous (" Hypurgon-condition "). The largest spicules are less than ·03 mm. in diameter. They have rather numerous blunt rays (Text-fig. 15 E).

The zooids are about 1·5 mm. long. The abdomen forms nearly half this length and the neck is nearly as long as the thorax. The neck is usually constricted just behind the middle. The retractor varies in length, but never extends beyond the abdomen. The extent to which it is attached to the neck is very variable. One or more vascular processes may spring from the posterior end of the neck, and may have knobbed ends. The branchial siphon is much broader than long when relaxed, slightly longer than broad when contracted (Text-figs. 15 B, C). The upper and lower edges of the atrial opening are more prominent than the sides. There are longitudinal thoracic muscle-bands, of which the most conspicuous on each side is dorsal (Text-fig. 15 B, C), and there are muscles on the transverse bars. There are 4 rows of stigmata, and about 10 in a row, but accurate counting is impossible. The dorsal languets are large. The thoracic tubercle lies over the second row of stigmata, rather nearer the dorsal than the ventral edge of the thorax. It projects into the test and appears to have a small round aperture at its apex (Text-fig. 15 B). The alimentary canal forms a long narrow loop (Text-fig. 15A). The stomach is large and its long axis is placed longitudinally. The first two sections of the intestine are directed straight backwards. The second section is thicker-walled than the first, and after it the intestine turns sharply forward. The gonads are beside the intestinal loop (Text-fig. 15D). The testis consists of 5–7 follicles, more or less closely packed according to their size. The vas deferens makes $1\frac{1}{2}$–2 turns. The ovary lies close to the testis on its outer surface.



TEXT-FIG. 15.—*Didemnum (Polysyncraton) magnetae* sp. n. A, Neck and abdomen. B, Dorsal view of thorax. C, Thorax seen from the right. D, Tip of abdomen. E, Spicules. (For explanation of lettering, see footnote, p. 73.)

Remarks.—This species is allied to *P. tubiporae* Michaelsen (1920, p. 9). They resemble each other in the arrangement of the zooids, the general structure of the test, and the size and shape of the spicules. Both have a layer of test which is free from spicules below the cloacal canals. The zooids are similar in size and shape, the proportions of thorax, neck and abdomen being characteristic. In both the testis is in the intestinal loop, with the ovary closely pressed to its outer surface. *P. magnetae* differs from *P. tubiporae* in the following points: There is no outer layer of bladder-cells, but this may have been lost, the colony having a rather worn appearance. The thoracic tubercles project outwards and have a small round aperture. The intestine is definitely divided into sections. The vas deferens only makes 1½–2 turns round the testis.

Diplosoma spongiforme (Giard) var. ? Michaelsen.

Diplosoma spongiforme var.? Michaelsen, 1930, p. 529.

Distribution.—S.W. Australia, Indian Ocean ?

Occurrence.—St. XIX (1 colony).

This specimen is a true *Diplosoma* of the *D. spongiforme* type. The colony is dappled black and light brown, owing to the presence of black pigment in the body-wall of some groups of zooids and its absence from others. In the pigmented zooids both thorax and abdomen are black and consequently opaque.

There can be very little doubt that this specimen belongs to the same species as Michaelsen's from S.W. Australia, but, as he has pointed out, it is at present impossible to determine its relationship to *D. spongiforme* and other similar forms.

Diplosoma virens (Hartmeyer). (Plate III, figs. A and B; Text-fig. 16.)

Leptoclinum virens Hartmeyer, 1909, p. 1456, nom. n. for
Diplosoma viride Herdman, 1906, p. 341, pl. viii, figs. 34–40, pl. ix, fig. 6.
non *Leptoclinum viride* Herdman, 1906, p. 340.

Distribution.—Ceylon.

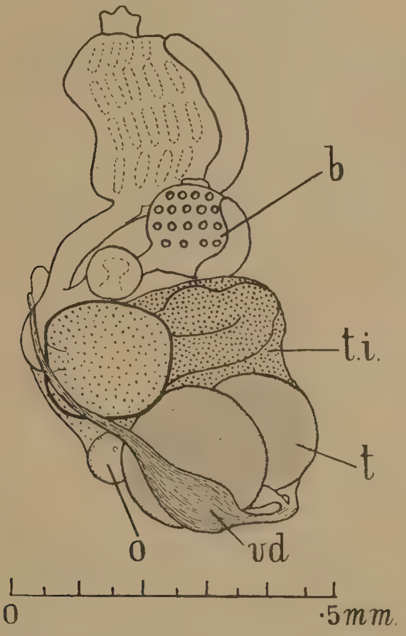
Occurrence.—Low Isles: G1, G3, F9, Reef Flat between F11 and IR1, IM1, Mangrove Park. Three Isles: Anchorage. Batt Reef: Patch No. 1.

After examination of the type material of *D. virens* (B.M. 07.8.30.42) some additions can be made to Herdman's description. There is a thin layer of test within the layer of bladder-cells and the centre of the colony is crossed by strands of test (" loose, lacunar test " of Herdman). The spherical green cells (Plate III, fig. A, *z*.) are only found in the spaces, not embedded in the test, and tend to be arranged in a single layer on the surface of the strands of test. It is, no doubt, the layer of these cells on the inner surface of the continuous layer of test that gives the optical effect of a dark green ring outside the zooids, which is mentioned by Herdman. The green cells are very numerous. The zooids, with a thin coating of test, are slung across the central cavity of the colony, only the branchial siphon being embedded in the main part of the test. The thorax in adult zooids is longer than in Herdman's figs. 39 and 40, which evidently represent young zooids. The stigmata, which are round in the buds, are fairly long in the adult. The constriction between thorax and abdomen is rather long. There is the usual bifid testis, with uncoiled vas deferens, which is dilated soon after leaving the testis.

Several congregations of small colonies from the Barrier Reef have been identified with Herdman's species. In life they were conspicuous for their green or blue colour.

Dr. C. M. Yonge has examined some of them, and finds that the spherical bodies are zooxanthellae. He thinks that the blue and green colours of the living colonies may be due to the combined effect of varying proportions of the yellow or brown colour of the zooxanthellae and a blue colour, presumably in the test. The green colour of these colonies would therefore not be of the same nature as that of the type-specimen, in which, according to Herdman, the algal cells were green. In the colonies from Ceylon with reddish-brown cells (*Diplosoma* sp. Herdman, 1906, p. 342) the general colour was reddish brown, not green. Dr. Yonge finds that the algal cells of the type are a different species from those in the Barrier Reef specimens.

Each colony has a single cloacal aperture. The specimens agree with *D. virens* in forming small, loosely-attached colonies with the test drawn out into processes, in having numerous bladder-cells in the outer layer of the test, in having their central cavities more or less filled with algal cells, in the shape and distribution of the vascular processes, and in the form of the zooids (Text-fig. 16).



TEXT-FIG. 16.—*Diplosoma virens* (Hartmeyer). Zooid from Barrier Reef. (For explanation of lettering, see footnote, p. 73.)

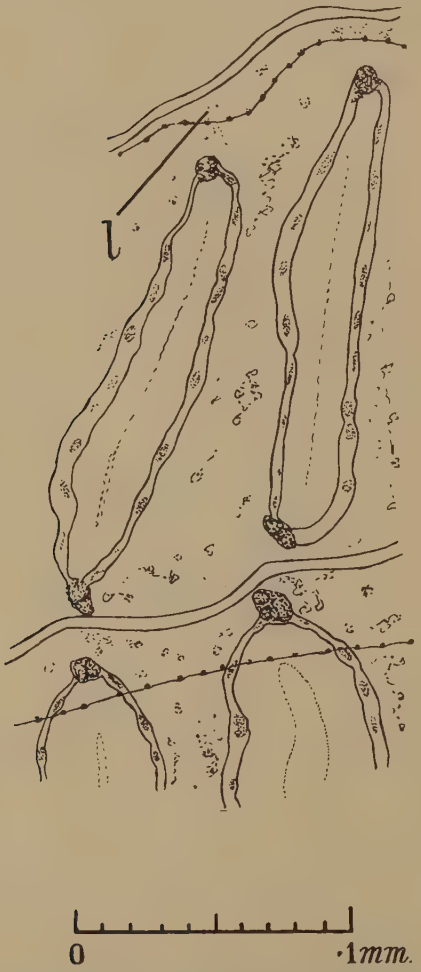
The chief difference is that in the Barrier Reef specimens strands of the test extending into the central cavity are not common, and are short and thick (Plate III, fig. B). There are differences in the main part of the test which may be due to less contraction in preservation, the bladder-cells being less closely packed and the inner layer being thicker and less dense. In the type this layer has a slightly striated appearance (*cf.* Plate III, figs. A and B).

Only three species of *Diplosoma* have been recorded from Australia, namely *D. rayneri* Macdonald (1859, p. 373), *Leptoclinum* (*Diplosoma*) *translucidum* Hartmeyer (1910, p. 1490) = *L. perspicuum* Sluiter (1909, p. 79), *D. spongiforme* var.? Michaelsen

(1930, p. 529). The two latter are clearly distinct from the present specimens, but *D. rayneri*, which was found at Port Jackson and has not been recorded since, agrees as far as its description goes. No mention is made, however, of any of the specific peculiarities of *D. virens*, some of which it is unlikely that Macdonald would have overlooked.

Diplosomoides ostrearium Michaelsen. (Text-fig. 17.)

Diplosomoides ostrearium Michaelsen, 1930, p. 526.



TEXT-FIG. 17.—*Diplosomoides ostrearium* Michaelsen. Stigmata seen from the inner surface of the branchial sac. Cilia omitted, the position of their tips indicated by dotted line. *l.*, lamina on transverse bar.

DISTRIBUTION.—Oyster Harbour, S.W. Australia.

OCCURRENCE.—Mangrove Park, on *Cymodocea.*

Two small colonies, the largest 7 mm. × 4 mm., agree with Michaelsen's description. Like his specimens, they are growing on a linear leaf. They are described as purple when alive. The branchial sac is large and very delicate. The stigmata are large, and the bars between them as wide as the stigmata. The epithelium on the stigmata consists of very flat cells with oval nuclei, and there are large, round cells in the angles (Text-fig. 17). A transparent membrane (*l*) projects inward from each transverse bar and has a row of nuclei in its edge. The thoracic tubercles are nearer to the endostyle than to the dorsal lamina. No reproductive organs were seen.

Michaelsen states that his species may be identical with one of the Malayan species of Gottschaldt or with *D. molle* Herdman (1886, p. 310). Examination of the type of *D. molle* (B.M. 87.2.4.446) shows that it is distinct. As in the specimens subsequently attributed to the species, there is a large, round cloacal opening at the summit of the more or less conical colony. The spicules are slightly more numerous in the surface layer than in *D. ostrearium*, and they are not found in the layer of test surrounding the zooids, except in the region of the thoracic tubercle. Their surface while in the tubercle is smoother than in those in the same position in *D. ostrearium*. These groups of spicules were not seen by Herdman (1891, p. 633). The tubercles themselves resemble those of *D. ostrearium* in form and position. The branchial sac is longer, being nearly twice as long as wide, and is not so delicate as that of the present specimens. The stigmata have the usual type of epithelium. The tentacles are thicker and less numerous. There is a pair of longitudinal muscles, mentioned by Herdman, on the dorsal edge of the thorax. They are continued into a retractor of unusual length, which, extending for a considerable distance beyond the abdomen, is conspicuous in the test. *D. ostrearium*, on the other hand, is without retractors.

Polyclinum macrophyllum subsp. *phortax* Michaelsen.

Polyclinum macrophyllum subsp. *phortax* Michaelsen, 1930, p. 546.

Distribution.—Shark's Bay, W. Australia.

Occurrence.—St. XXIII (1 colony).

This colony corresponds closely with Michaelsen's description. As in subsp. *typicum* the post-abdomen lies beside the abdomen, but, as pointed out by Michaelsen, this depends on the thickness of the colony. There is a wide cavity between the mantle and the branchial sac, traversed by conspicuous vessels which join the transverse vessels of the branchial sac. Zooids with a row of small, irregular stigmata were seen, and this row was not always the most posterior. The cloacal opening is bordered by finger-like processes occupied by parts of the tips of the atrial languets as figured by Michaelsen (1930, p. 54) in *P. constellatum*. There is a short atrial siphon.

THALIACEA AND APPENDICULARIA.

The details of the distribution of these groups of Tunicata will be found in Dr. Russell's report on the Plankton and, as the specimens call for no comment, it is sufficient to give a list of the species and a selection of references to the literature. *Megalocercus huxleyi* is only known from the Indo-Pacific region (Ihle, 1929). The other species are very widely distributed, being found, at least in the warmer waters, in the Atlantic, Pacific and Indian Oceans.

The absence of *Oikopleura cophocerca* is rather surprising. It was found, with the three species here recorded, on the S.W. coast of Australia (Lohmann, 1909, p. 144) and in the Malayan region (Ihle, 1908, p. 118). A rather large proportion of the specimens of *Oikopleura* are unfit for certain identification, but there is no reason to suppose that there are among these any species not represented by those better preserved. Three individuals of *O. rufescens* had the more horizontal rectum described by Ihle (1908, p. 114).

Cyclosalpa pinnata (Forskål).

Salpa pinnata Forskål, 1775, p. 113.
Cyclosalpa pinnata Metcalf, 1918, p. 9, text-figs. 1–14, pls. i, ii (synonymy).

Salpa democratica Forskål.

Salpa democratica Forskål, 1775, p. 113.
Thalia democratica Sewell, 1926, p. 92, text-figs. 20–26 (synonymy).

Salpa zonaria (Pallas).

Holothurium zonarium Pallas, 1774, p. 27, pl. i, fig. 17 A, B, C.
Jasis zonaria Sewell, 1926, p. 88, text-figs. 18, 19 (synonymy).

Salpa cylindrica Cuvier.

Salpa cilindrica Cuvier, 1804, p. 381, pl. lxviii, figs. 8, 9.
Salpa cylindrica Sewell, 1926, p. 77, text-figs. 7–13 (synonymy).

Salpa confoederata Forskål.

Salpa confoederata Forskål, 1775, p. 115.
Pegea confoederata Sewell, 1926, p. 100, text-figs. 28–33. (synonymy.)

Salpa rostrata Traustedt.

Salpa rostrata Traustedt, 1893, p. 8, pl. i, figs. 1–4; Apstein, 1894, p. 16, pl. ii, figs. 9, 10, 17–22, text-fig. ix; Ihle, 1910, p. 27, pl. i, fig. 17.
Brooksia rostrata Metcalf, 1918, p. 50, text-figs. 22–24.

Doliolum denticulatum Q. & G.

Doliolum denticulatum Quoy & Gaimard, 1834, p. 599, pl. lxxxix, figs. 25–28; Neumann, 1906, p. 222, pl. xxiv, fig. 1 (development, pp. 100–206, figs.); Ihle, 1910, p. 15.

Doliolum tritonis Herdman.

Doliolum denticulatum Herdman, 1887, p. 101, pls. xviii–xx.
Doliolum tritonis Herdman, 1888, p. 47, pl. iii, fig. 3; Neumann, 1906, p. 220; Ihle, 1910, p. 14.

Asexual Doliolum.

Asexual specimens of *Doliolum* are not abundant in the collection, and the species of none of those found could be identified.

Fritillaria haplostoma Fol.

Fritillaria aplostoma Fol, 1872, p. 478, pl. vi, fig. 6.
Fritillaria haplostoma Lohmann 1896, p. 39, pl. v, figs. 1–3, 6 ; Ihle, 1908, p. 93 ; Essenberg, 1926, p. 442, text-figs. 52–56.

Oikopleura longicauda (Vogt).

Appendicularia longicauda Vogt, 1854, p. 74, pl. x, figs. 4–6.
Oikopleura longicauda Lohmann, 1896, p. 59, pls. ix, x, fig. 7 ; 1901, p. 19, text-fig. 23; Ihle, 1908, p. 111, pl. iii, figs. 40–43 ; Essenberg, 1926, p. 487, text-figs. 130–132.

Oikopleura fusiformis Fol.

Oikopleura fusiformis Fol, 1872, p. 473, pl. iii, figs. 5–8 ; Lohmann, 1896, p. 63, pl. xvi, fig. 3, pl. xvii, figs. 5, 7, 8 ; 1901, p. 20, text-fig. 24 ; Ihle, 1908, p. 113 ; Essenberg, 1926, p. 494, text-figs. 140–142.

Oikopleura rufescens Fol.

Oikopleura rufescens Fol, 1872, p. 471, pl. x, fig. 3 ; Lohmann, 1896, p. 74, pl. xvi, figs. 2, 4, pl. xvii, figs. 1–3, 6 ; Ihle, 1908, p. 114, pl. iv, figs. 69–73 ; Essenberg, 1926, p. 491, text-figs. 136–139.

Stegosoma magnum (Langerhans).

Oikopleura magna Langerhans, 1880, p. 145, pl. vi, fig. 73.
Stegosoma magnum Lohmann, 1896, p. 79, pl. xviii ; Ihle, 1908, p. 115 ; Essenberg, 1926, p. 505, text-figs. 154–158.

Megalocercus huxleyi (Ritter & Byxbee).

Oikopleura huxleyi Ritter & Byxbee, 1905, p. 206, pl. ii, figs. 9–11.
Megalocercus huxleyi Ihle, 1908, p. 98, pl. i, fig. 1–8, pl. ii, figs. 9–13, 16–22, pl. iii, figs. 31, 32, 37–39, text-figs. 9, 10 ; Lohmann, 1914, p. 353, text-figs. 1, 2*a*, 3*a* and *c*, 4*a*, 5, 6*a*.

REFERENCES.

Apstein, C. 1894. Die Thaliacea der Plankton-Expedition. B. Vertheilung der Salpen. Henson, V. Ergebn. Plankton-Exp. IIE. a.B., pp. 68, 1 pl., 2 maps, text illust.

Ärnbäck-Christie-Linde, A. 1923. Northern and Arctic Invertebrates in the Collection of the Swedish State Museum. Tunicata II, Botryllidae. K. svenska VetenskAkad. Handl. LXIII, no. 9, pp. 1–25, 1 pl., 8 text-figs.

Cuvier, G. 1804. Sur les Thalides (*Thalia*, Brown), et sur les Biphores (*Salpa*, Forskaohl.). Ann. Mus. Hist. nat. Paris, IV, pp. 360–382, 1 pl.

Essenberg, C. E. 1926. Copelata from the San Diego Region. Univ. Calif. Pub. Zool. XXVIII, pp. 399–521, 170 text-figs.

Fol, H. 1872. Etudes sur les Appendiculaires du Détroit de Messine. Mém. Soc. phys. Genève, XXI, pp. 445–499, 11 pls.

Forskål, P. 1775. Descriptiones Animalium, pp. 164, 1 map.

Gottschaldt, R. 1898. Synascidien von Ternate. Abh. senckenb. naturf. Ges. XXIV, pp. 641–660, 2 pls.

Hartmeyer, R. 1907. Ein Beitrag zur Kenntnis der japanischen Ascidienfauna. Zool. Anz. Leipzig, XXXI, pp. 1–30, 12 text-figs.

—— 1909–11. Tunicata. Bronn. Tier-reichs. III suppl., pp. 1280–1773, 41 pls.

—— 1912. Die Ascidien der Deutschen Tiefsee-Expedition. Wiss. Ergebn. Deutsch. Tiefsee-Exp. XVI, hft. 3, pp. 225–392, 8 pls., 10 text-figs.

—— 1913. Tunicata. Forschungsreise W. & Zentr. S. Afrika, V, lief, 2. Denkschr. med.-naturw. Ges. Jena, XVII, pp. 127–144, 2 pls., 6 text-figs.

HARTMEYER, R. 1915. Über einige Ascidien aus dem Golf von Suez. SitzBer. Ges. naturf. Fr. Berl. 1915, no. 9, pp. 397–430, 14 text-figs.

—— 1919. Ascidien. Res. Swed. Sci. Exp. Australia, XXV. K. svenska VetenskAkad. Handl. LX, no. 4, pp. 1–150, 2 pls., 23 text-figs.

—— 1927. Zur Kenntnis phlebobranchiater und diktyobranchiater Ascidien, Mitt. Zool. Mus. Berlin, XIII, pp. 159–196, 18 text-figs.

—— and MICHAELSEN, W. 1928. Ascidiae Diktyobranchiae und Ptychobranchiae. Michaelsen, W., and Hartmeyer, R. Fauna Südwest Australiens, V, lief. 6, pp. 253–460, 61 text-figs.

HELLER, C. 1878. Beiträge zur nähern Kenntniss der Tunicaten. SitzBer. Akad. Wiss. Wien, LXXVII, abt. 1, pp. 83–110, 6 pls.

HERDMAN, W. A. 1882*a*. Preliminary Report on the Tunicata of the "Challenger" Expedition. III, Cynthiadae. Proc. Roy. Soc. Edinb. XI, pp. 52–88.

—— 1882*b*. Report on the Tunicata . . . I. Ascidiae Simplices. Rep. Zool. Chall. Exp. VI, part 17, pp. 293, 37 pls., 23 text-figs.

—— 1886. Report on the Tunicata . . . II. Ascidiae Compositae. Rep. Zool. Chall. Exp. XIV, part 38, pp. 429, 49 pls., 15 text-figs., 1 map.

—— 1887. Report on the Tunicata Collected during the Cruise of H.M.S. "Triton." . . . Trans. Roy. Soc. Edinb. XXXII, pp. 93–117, 5 pls.

—— 1888. Report on the Tunicata . . . III. Rep. Zool. Chall. Exp. XXVII, part 76, pp. 163, 11 pls., 28 text-figs.

—— 1891. A Revised Classification of the Tunicata. J. Linn. Soc. Zool. XXIII, pp. 558–652.

—— 1899. Descriptive Catalogue of the Tunicata in the Australian Museum, Sydney, N.S.W. Cat. Austr. Mus. XVII, pp. xviii, 139, 45 pls.

—— 1906. On the Tunicata. Roy. Soc., London. Rep. Pearl Oyster Fisheries Manaar, Suppl. Rep. XXXIX, pp. 295–348, 9 pls.

HUNTSMAN, A. G. 1913. The Classification of the Styelidae. Zool. Anz. Leipzig, XLI, pp. 482–501, 13 text-figs.

IHLE, J. E. W. 1908. Die Appendicularien der Siboga-Expedition. Weber, M. C. W., Rep. Siboga Exp. LVI*c*, pp. 123, 4 pls., 10 text-figs.

—— 1910. Die Thaliaceen der Siboga-Expedition. Weber, M. C. W., Rep. Siboga Exp. LVI*d*, pp. 55, 1 pl., 6 text-figs.

—— 1929. Über *Megalocercus diegensis* Essenberg. Zool. Anz. Leipzig, LXXXV, pp. 333–335.

LANGERHANS, P. 1880. Über Madeiras Appendicularien. Z. wiss. Zool. Leipzig, XXXIV, pp. 144–146, 1 pl.

LOHMANN, H. 1896. Die Appendicularien der Plankton-Expedition. Hensen, V., Ergebn. Plankton-Exp. II, E. c., pp. 148, 24 pls.

—— 1901. Appendicularien. Brandt, K. A. H., Nord. Plank. Zool. II, pp. 11–29, 16 text-figs.

—— 1909. Copelata und Thaliacea. Michaelsen, W., and Hartmeyer, R., Die Fauna Südwest Australiens, II, lief. 10, pp. 143–149, 1 text-fig.

—— 1914. Die Appendicularien-Gattung *Megalocercus*. Jahrb. Hamburg Wiss. Anst. XXXI, beiheft 2, pp. 353–366, 8 text-figs.

MACDONALD, J. D. 1859. On the Anatomical Characters of a Remarkable Form of Compound Tunicata. Trans. Linn. Soc. London, XXII, 4, pp. 373–375, 1 pl.

METCALF, M. M. 1918. The Salpidae: a Taxonomic Study. Bull. U.S. Nat. Mus. 100, 2, pp. 1–193, 13 pls., 146 text-figs.

MICHAELSEN, W. 1904. Revision der compositen Styeliden oder Polyzoinen. Jahrb. Hamburg Wiss. Anst. XXI, beiheft 2, pp. 1–124, 2 pls., 1 text-fig., 1 map.

—— 1911. Die Tethyiden (Styeliden) des Naturhistorischen Museum zu Hamburg. Jahrb. Hamburg Wiss. Anst. XXVIII, beiheft 2, pp. 109–186, 25 text-figs.

—— 1914. Über einige westafrikanische Ascidien. Zool. Anz. Leipzig, XLIII, pp. 423–432.

—— 1915. Tunicata. Beitr. Meeresfauna Westafrikas. I, lief. 3, pp. 321–518, 4 pls., 4 text-figs.

—— 1919. Zur Kenntnis der Didemniden. Abh. Naturw. Hamburg, XXI, hft. 1, pp. 1–44, 3 text-figs.

—— 1920. Die Krikobranchen Ascidien des westlichen Indischen Ozeans: Didemniden. Jahrb. Hamburg Wiss. Anst. XXXVII, beiheft, pp. 1–74, 2 pls., 6 text-figs.

—— 1921*a*. Ascidien vom westlichen Indischen Ozean aus dem Reichsmuseum zu Stockholm. Ark. Zool. Stockholm, XIII, no. 23, pp. 1–25, 1 pl.

—— 1921*b*. Ascidiae Krikobranchiae des Roten Meeres: Clavelinidae und Synoicidae. Denkschr. Akad. Wiss. Wien, Math.-nat. Kl. XCVII, Ber. Komm. Ozean. Forsch. pp. 1–38, 1 pl., 1 text-fig.

MICHAELSEN, W. 1923. Neue und altbekannte Ascidien aus dem Reichsmuseum zu Stockholm. Mitt. Zool. Mus. Hamburg, XL, pp. 1–60, 12 text-figs.

—— 1924. Ascidiae Krikobranchiae von Neuseeland, den Chatham- und den Auckland-Inseln. Vidensk. Medd. naturh. Foren. Kjøb. LXXVII, pp. 263–434, 30 text-figs.

—— 1927. Einige neue Westaustralische Ptychobranchiate Ascidien. Zool. Anz. Leipzig, LXXI, pp. 193–203.

—— 1930. Ascidiae Krikobranchiae. Michaelsen, W., and Hartmeyer, R. Die Fauna Südwest Australiens, V, lief. 7, pp. 463–558, 12 text-figs.

NEUMANN, G. 1906. Doliolum. Wiss. Ergebn. Deutsch. Tiefsee-Exped. XII, lief. 2, pp. 95–243, 15 pls., 20 text-figs.

NOTT, J. T. 1892. On the Composite Ascidians of the North Shore Reef. Trans. Proc. N.Z. Inst. XXIV, pp. 305–334, 7 pls.

PALLAS, P. S. 1774. Spicilegia Zoologica, I, fasc. 10, pp. 41, 3 pls.

PIZON, A. 1908. Ascidies d'Amboine. Rev. Suisse Zool. Genève, XVI, pp. 195–240, 6 pls.

QUOY, J. R. C., and GAIMARD, J. P. 1834. Voyage de l'Astrolabe, Zool. III, pp. 559–626, Atlas, 1833, pls. lxxxvi–xcii.

RITTER, W. E., and BYXBEE, E. S. 1905. The Pelagic Tunicata. Mem. Harv. Mus. Comp. Zoöl. XXVI, pp. 195–214, 2 pls.

SAVIGNY, J. C. 1816. Mémoires sur les Animaux sans Vertèbres, part II, fasc. 1, pp. 83–239, pls. i–xxiv.

SEWELL, R. B. S. 1926. The Salps of Indian Seas. Rec. Ind. Mus. Calcutta, XXVIII, pp. 65–126, 43 text-figs.

SLUITER, C.-PH. 1886. Über einige einfachen Ascidien von der Insel Billiton. Natuurk. Tijdschr. Ned.-Ind. XLV, pp. 160–232, 9 pls.

—— 1887. Einfache Ascidien aus der Bai von Batavia. Natuurk. Tijdschr. Ned.-Ind. XLVI, pp. 242–266, 3 pls.

—— 1891. Die Evertebraten aus der Sammlung des Königlichen naturwissenschaftlichen Vereins in Niederländisch Indien in Batavia. Ascidiae Simplices. Natuurk. Tijdschr. Ned.-Ind. L, pp. 329–348, 2 pls.

—— 1895. Tunicaten. Semon, R. W., Zool. Forschungsreisen in Australien, etc. V, lief. 2, pp. 163–186, 5 pls.

—— 1904. Die Tunicaten der Siboga-Expedition. I, Die Socialen und Holosomen Ascidien. Weber, M. C. W., Rep. Siboga Exp. LVI*a*, pp. 125, 15 pls.

—— 1905. Tuniciers recueillis en 1904, par M. Ch. Gravier, dans le Golfe de Tadjourah. Mém. Soc. zool. Fr. XVIII, pp. 1–21, 2 pls.

—— 1909. Die Tunicaten der Siboga-Expedition. II, Die Merosomen Ascidien. Weber, M. C. W., Rep. Siboga Exp. LVI*b*, pp. 112, 8 pls.

—— 1919. Über einige alte und neue Ascidien aus dem Zoologischen Museum von Amsterdam. Bijdr. Dierkunde, Leiden, XXI, pp. 1–12, 1 pl.

—— 1927. Les Ascidies de la Côte atlantique du Maroc. Bull. Soc. Sci. nat. Maroc, VII, pp. 50–99, 2 pls., 11 text-figs.

SOLLAS, I. B. J. 1903. On *Hypurgon skeati*, a new Genus and Species of Compound Ascidians. Quart. J. Micr. Sci. XLVI, pp. 729–735, 2 pls.

STIMPSON, W. 1856. Descriptions of Some New Marine Invertebrata. Proc. Acad. Nat. Sci. Philad. VII, pp. 385–395.

TRAUSTEDT, M. P. A. 1893. Die Thaliacea der Plankton-Expedition. Henson, V. A. C., Ergebn. Plankton-Exp. II, E.a.A., pp. 16, 1 pl.

VAN NAME, W. G. 1918. Ascidians from the Philippines and Adjacent Waters. Bull. U.S. Nat. Mus. 100, I, pp. 49–174, 11 pls., 115 text-figs.

—— 1921. Ascidians of the West Indian Region and South-Eastern United States. Bull. Amer. Mus. Nat. Hist. N.Y. XLIV, pp. 283–494, 159 text-figs.

—— 1924. Ascidians from Curaçao. Bijdr. Dierkunde, Leiden, XXIII, pp. 23–32, 7 text-figs.

VERRILL, A. E. 1871. Descriptions of New and Imperfectly Known Ascidians from New England. Amer. J. Sci. New Haven, ser. 3, I, pp. 443–446, 1 text-fig.

VOGT, C. 1854. Sur les Tuniciers nageants de la Mer de Nice. Mém. Inst. nat. genev. II, pp. 3–102, 6 pls.

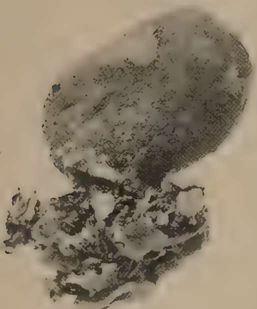
DESCRIPTION OF PLATE I.

A and B, *Polycarpa ovata* Pizon. Natural size. B, After removal of test.

C, *Eudistoma ovatum* (Herdman) from Cape Boileau, N.W. Australia. × ½.

D and E, *Podoclavella meridionalis* Herdman. Natural size. D, From the Barrier Reef. E, From Cape Boileau.

F, *Podoclavella molluccensis* Sluiter from Cape Boileau. Natural size.



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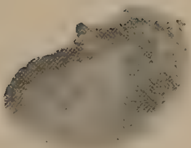

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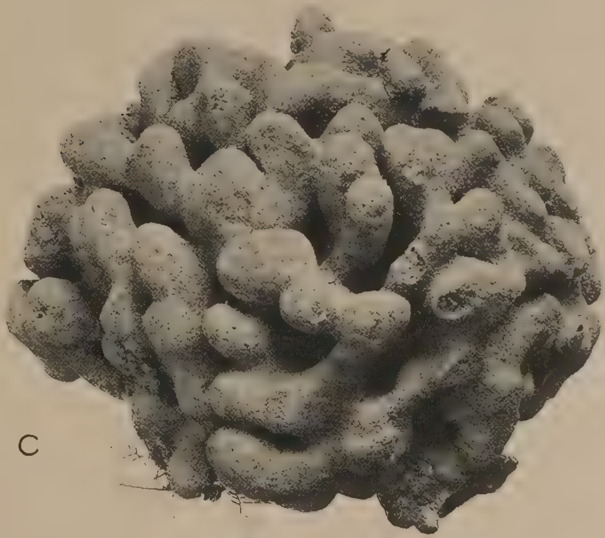

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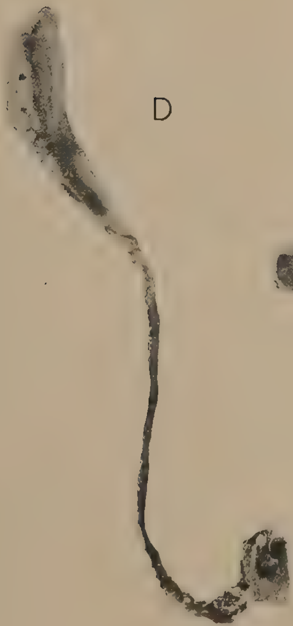

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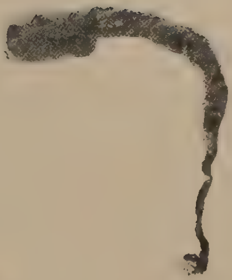
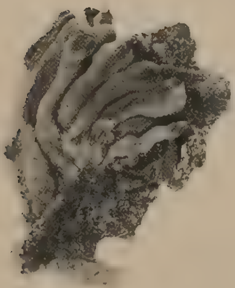


E



F

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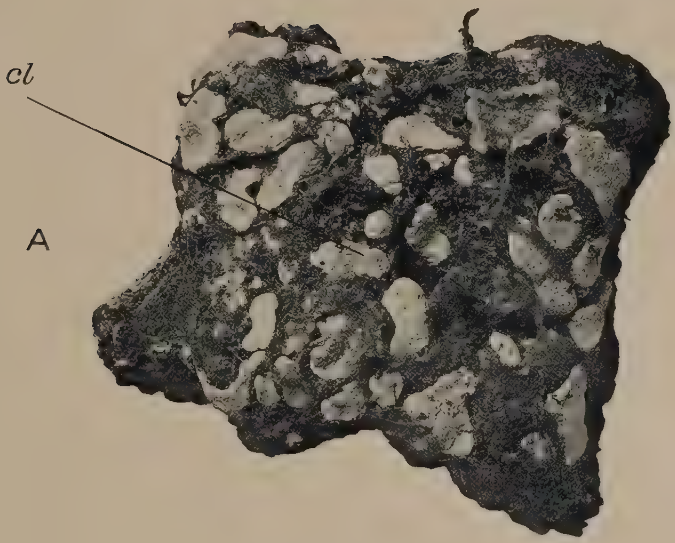
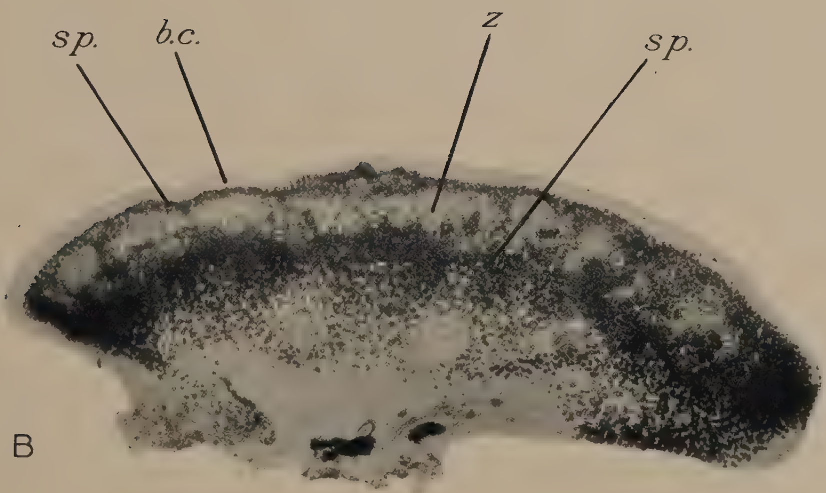
DESCRIPTION OF PLATE II.

A, *Didemnum candidum* Sav., pink form, from Thalamita Flat, Low Isles. Natural size. Several cloacal apertures are visible.

B, *Trididemnum cyclops* Michaelsen. × 24. Vertical section. *b.c.* Bladder-cell layer. *cl.a.* Cloacal aperture. *z.* algal cells. *sp.* Spicules.



A



B

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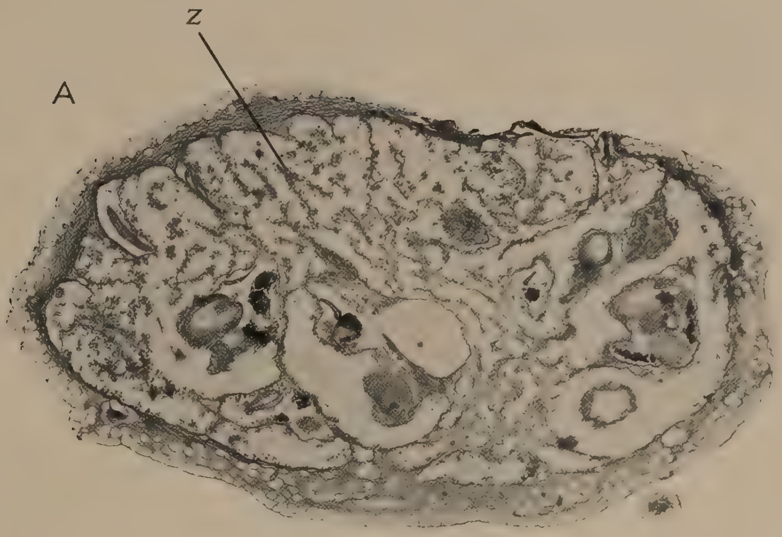
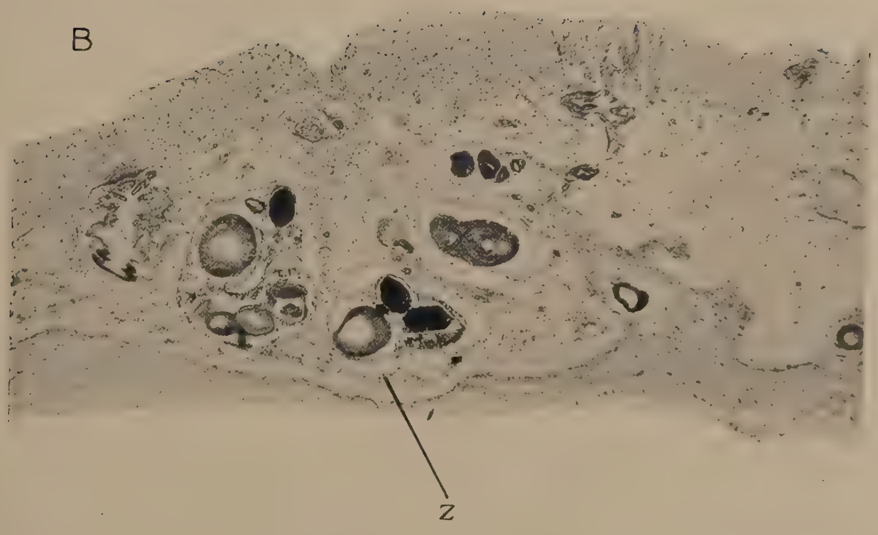
DESCRIPTION OF PLATE III.

A and B, Sections of *Diplosoma virens* (Hartmeyer). × 56. A, Type-specimen from Ceylon. B, Colony from Mangrove Park, Low Isles. *z.* Algal cells.





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AMPHIPODA

BY

K. H. BARNARD, D.Sc., F.L.S.,
South African Museum, Cape Town.

WITH FOUR TEXT-FIGURES

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INTRODUCTION.

THE collection of Amphipods obtained by the naturalists of the Great Barrier Reef Expedition is not a large one. That is mainly due to the Expedition being designed, not so much for collecting purposes, as for ecological and experimental work.

Small as it is, however, the collection is an interesting one. It contains species not hitherto recorded from the Australian coasts, one species which has not been collected since its description in 1880, and three species which it seems advisable to regard as undescribed. By far the greater part of the collection consists of planktonic Hyperiids.

The collection serves to show what a vast field awaits anyone with the opportunity of carrying out intensive investigation, with special methods, of the Amphipodan fauna of the Australian coasts.

My thanks are due to Dr. W. T. Calman, F.R.S., of the British Museum, for the opportunity of studying this collection; and to Dr. T. A. Stephenson, who was a member of the Expedition, for information relative to the various species.

As regards the Gammarids there is little to be said. Fourteen species were collected, and of these four, including the three new species, all came from one station (St. 29). Ten species were found at Low Isles, including one widely-distributed pelagic form. The material of some species was too scanty for specific determination, belonging to the difficult genera *Maera*, *Hyale*, and *Ampithoe*.

The re-discovery of *Xenocheira* in Australian waters is interesting, though here again unfortunately only a single specimen is available.

With regard to the apparent poverty of Gammarids, Dr. Stephenson has supplied me with the following note : " The small number of Gammarids collected from the intertidal region at Low Isles is due partly to the fact that many of them live among coral shingle and can only be caught by the expenditure of much time ; but it is probably also the reflection of a genuine (relative) poverty in the intertidal Gammarid fauna. On an English shore the Gammarids form a very noticeable element, whereas at Low Isles it was often difficult to find any, except in certain places where they were abundant.

" The collection of planktonic Amphipods from the station 3 miles east of Low Isles, on the other hand, may probably be regarded as a series very fairly representative of the Amphipod fauna of that area, since these collections were made systematically once a week throughout a period of twelve months, and contain a considerable number of specimens."

The most abundant Hyperiid is undoubtedly *Hyperia sibaginis*, Stebb., which occurred, usually in quantity, at 41 stations. It would be more accurate to say it occurred on 41 occasions, as 34 of the occasions were at the weekly station. About 750 specimens were obtained (see also *infra*, p. 127).

The next most abundant species were as follows :

Tullbergella cuspidata	87 specimens at	23 stations	(3 localities).
Lycaea bajensis	60 ,,	9 ,,	(1 locality).
Tetrathyrus forcipatus	34 ,,	9 ,,	(3 localities).
Simorhynchotus antennarius	21 ,,	11 ,,	(3 ,,).
Glossocephalus milne-edwardsi	15 ,,	10 ,,	(4 ,,).

The other species were obtained mostly as solitary specimens at a few, or at single, stations.

All the species are well known, or moderately well known, tropical and sub-tropical species of wide distribution. *Lycaea bajensis* and *Eupronoe laticarpa* are the only two which have not been widely recorded, unless the former is synonymous with *L. pulex* (see Pirlot, 1930, p. 25).

LIST OF STATIONS AT WHICH AMPHIPODA WERE COLLECTED, WITH THE SPECIES OBTAINED AT EACH STATION.*

Low Isles. M7. Shore collection. 20.iii.29.
Ampithoe, sp.

Low Isles. Shore collection. Tripneustes Spit. 21.iii.29.
Hyale, sp.

Low Isles. F9. Shore collection. 4.iv.29.
Hyale, sp.

Low Isles. F8. Shore collection. 10.iv.29.
Maera, sp.
Ceradocus rubromaculatus (Stimpson.).

---

* Station numbers in Roman numerals refer to dredgings. Those in Arabic numerals refer to the list of plankton stations in Vol. II, No. 2 (Russell and Colman, " The Zooplankton : I. Gear, Methods and Station Lists "). Shore collection numbers refer to the Key Chart of Low Isles in Vol. III, No. 2 (Stephenson and Others, " The Structure and Ecology of Low Isles and other Reefs," p. 23).

Low Isles. F5. Shore collection. 24.iv.29.
Ceradocus rubromaculatus (Stimpson.).

Low Isles. Lagoon. 20.vii.28.
Tullbergella cuspidata, Bov.

Low Isles. Anchorage. 1.x.28. Small medium tow-net, night haul.
Perioculodes aequimanus (Kossm.).

Low Isles. Anchorage. 20.xi.28. Coarse tow-net, day haul.
Synopia ultramarina, Dana.

Low Isles. Anchorage. 29.xi.28. Coarse tow-net, surface, night haul.
Synopia ultramarina, Dana.

Low Isles. Over reef flat. 16.v.29. Small medium tow-net, day.
Pontharpinia rostrata (Dana).
Xenocheira fasciata, Hasw.

Low Isles. Shore collection. (E. A. Fraser.)
Hyale sp.

Station XVI. 9.iii.29. ½ mile W. of N. Direction Is., 20 fathoms, stony.
Leucothoe spinicarpa (Abildg.). From Tunicates.

Station XIX. 10.iii.29. ½ mile N. of Eagle Is., 10 fathoms, shell gravel.
Leucothoe spinicarpa (Abildg.). } From Tunicates and Sponges.
,, *furina* (Sav.). }

Station XXII. 11.iii.29. To E. of Snake Reef. 13½ fathoms, mud.
Leucothoe furina (Sav.). From Tunicates.

Station 1. 27.vii.28. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Hyperia sibaginis, Stebb.

Station 2. 30.vii.28. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Vibilia viatrix, Bov.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 3. 4.viii.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.

Station 4. 7.viii.28. 1 mile N. of Low Isles. C. net, horizontal, surface.
Simorhynchotus antennarius (Claus).
Parascelus edwardsii, Claus.

Station 5. 11.viii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 6. 17.viii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 7. 22.viii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 8. 24.viii.28. 16° 30′ S., 145° 52′ E. Trinity Opening. 45 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Parascelus edwardsii, Claus.

Station 9. 31.viii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 10. 4.ix.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 11. 6.ix.28. 16° 24′ S., 145° 52′ E. Trinity Opening. 61 metres. S. and C. nets, oblique.
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.

Station 11. 6.ix.28. 16° 24′ S., 145° 52′ E. Trinity Opening. 61 metres. Nansen net vertical.
Eupronoe maculata, Claus.

Station 12. 11.ix.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 13. 20.ix.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 15. 2.x.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Eupronoe laticarpa, Steph.
Sympronoe parva (Claus).

Station 16. 3.x.28. 3 miles E. of Low Isles. 32 metres. C.-Cl. net, horizontal.
Hyperia sibaginis, Stebb.
Eupronoe maculata, Claus.
Tullbergella cuspidata, Bov.

Station 17. 8.x.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Tullbergella cuspidata, Bov.

Station 18. 15.x.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 19. 20.x.28. 16° 20′ S., 146° 3′ E. Outside Trinity Opening. S. net, vertical, 180 m.w.o., bottom 225 metres.
Scina tullbergi (Bov.).
Hyperia sibaginis, Stebb.
Leptocotis tenuirostris (Claus).

Station 20. 20.x.28. 16° 19′ S., 146° 7′ E. Outside Trinity Opening. Nansen net, vertical, 250 m.w.o., bottom 600 plus metres.
Primno macropa, Guer.
Lycaeopsis themistoides, Claus.

Station 21. 22.x.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique, night haul.
Synopia ultramarina, Dana.
Sympronoe parva (Claus).
Lycaea bajensis, Shoem.
Simorhynchotus antennarius (Claus).

Station 22. 23.x.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Eupronoe maculata (Claus).

Station 23. 2.xi.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Eupronoe maculata (Claus).
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.

Station 24. 6.xi.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Vibilia armata, Bov.
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.

Station 26. 19.xi.28. 16° 24′ S., 145° 53½ E. Trinity Opening. 57 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 27. 21.xi.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 28. 23.xi.28. 16° 19′ S., 146° 5′ E. Outside Trinity Opening. S. net, vertical, 600 m.w.o., bottom 600 plus metres.
Vibilia armata, Bov.
Paraphronima crassipes, Claus.
Oxycephalus clausi, Bov.

Station 29. 24.xi.29. 16° 17′ S., 146° 2′ E. Outside Trinity Opening. B.S. net, 205 metres.
Ampelisca acinaces, Stebb.
Pardalisca australiensis, n. sp.
Oediceroides apicalis, n. sp.
Rhachotropis platycera, n. sp.
Tetrathyrus forcipatus, Claus.

Station 30. 28.xi.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Simorhynchotus antennarius (Claus).

Station 30A. 29.xi.28. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Simorhynchotus antennarius (Claus).

Station 31. 2.xii.28. 3 miles E. of Low Isles. 32 metres. B.S. net.
Hyperia sibaginis, Stebb.

Station 32. 5.xii.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Rhabdosoma armatum (M. Edw.).
,, *whitei*, Bate.
Tetrathyrus forcipatus, Claus.

Station 33. 14.xii.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.

Station 34. 19.xii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 35. 27.xii.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.
Oxycephalus clausi, Bov.
Rhabdosoma whitei, Bate.

Station 36. 4.i.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Glossocephalus milne-edwardsi, Bov.
Rhabdosoma whitei, Bate.

Station 37. 14.i.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.

Station 39. 30.i.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Brachyscelus globiceps (Claus).

Station 40. 6.ii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Vibilia viatrix, Bov.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.
Tetrathyrus forcipatus, Claus.

Station 41. 13.ii.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Tullbergella cuspidata, Bov.
Tetrathyrus forcipatus, Claus.

Station 42. 18.ii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Simorhynchotus antennarius (Claus).

Station 43. 26.ii.29. 15° 16′ S., 145° 26½′ E. Off Cape Bedford. 30 metres. S. net, oblique.
Glossocephalus milne-edwardsi, Bov.

Station 44. 27.ii.29. 14° 44′ S., 145° 27½′ E. Off Lizard Is. 31 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 45. 28.ii.29. 14° 31′ S., 145° 35′ E. Outside Cook's Passage. S. net, vertical, 500 m.w.o., bottom 600 plus metres.
Scina lepisma, Chun.
Hyperia sibaginis, Stebb.
Primno macropa, Guer.
Brachyscelus globiceps (Claus).
Tetrathyrus forcipatus, Claus.

Station 46. 28.ii.29. 14° 32′ S., 145° 32′ E. Inside Cook's Passage. 33 metres. S. net, oblique.
Simorhynchotus antennarius (Claus).
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.

Station 47. 4.iii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Simoryhnchotus antennarius (Claus).
Glossocephalus milne-edwardsi, Bov.

Station 48. 15.iii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Glossocephalus milne-edwardsi, Bov.

Station 49. 17.iii.29. 15° 47′ S., 145° 47′ E. Inside Papuan Pass. 46 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Lycaeopsis zamboangae (Stebb.).
Brachyscelus globiceps (Claus).
Simorhynchotus antennarius (Claus).

Station 50. 18.iii.29. Outside Papuan Pass. S. net, 400 m.w.o., bottom 400 metres.
Hyperia sibaginis, Stebb.
Eupronoe maculata (Claus).
Brachyscelus globiceps (Claus).

Station 51. 25.iii.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Tullbergella cuspidata, Bov.

Station 52. 6.iv.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Simorhynchotus antennarius (Claus).
Tetrathyrus forcipatus, Claus.

Station 53. 13.iv.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Hyperia sibaginis, Stebb.

Station 54. 20.iv.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Hyperia sibaginis, Stebb.

Station 55. 26.iv.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 56. 7.v.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.
Tetrathyrus forcipatus, Claus.

Station 57. 18.v.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.

Station 58. 25.v.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.
Simorhynchotus antennarius (Claus).

Station 59. 31.v.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.
Tetrathyrus forcipatus, Claus.

Station 60. 7.vi.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.

Station 61. 14.vi.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 63. 24.vi.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Hyperia sibaginis, Stebb.

Station 66. 11.vii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Simorhynchotus antennarius (Claus).
Glossocephalus milne-edwardsi, Bov.

Station 67. 17.vii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets. oblique.
Hyperia sibaginis, Stebb.
Tetrathyrus forcipatus, Claus.

SYSTEMATIC NOTES AND DESCRIPTIONS OF NEW SPECIES.

GAMMARIDEA.

Family AMPELISCIDAE.

Genus *Ampelisca*, Krøyer.

Ampelisca acinaces, Stebbing.

Stebbing, 1906, p. 108, figs. 25, 26.

OCCURRENCE.—St. 29. 7 specimens 5–7·5 mm.

REMARKS.—These specimens agree well with *acinaces*, except that the postero-inferior angle of pleon segment 3 is produced in a distinct acute point, with the margin above it sinuous, and that the 6th joint of peraeopod 5 is markedly ovate, being wider than the 3rd, 4th or 5th joints. Second joint of mandibular palp linear.

DISTRIBUTION.—East Australia.

Family PHOXOCEPHALIDAE.

Genus *Pontharpinia*, Stebbing.

Pontharpinia rostrata (Dana).

(Fig. 1.)

Stebbing, 1906, p. 146.

OCCURRENCE.—Low Isles. Over reef flat. 12 ♂♂ 3 mm.

REMARKS.—These specimens are attributed to Dana's species with a certain amount of reserve. They are not in conflict with Dana's figure as reproduced in Bate ('Cat. Amphip. Crust. B.M.,' 1862, p. 118, pl. xx, fig. 4); in fact Dana's delineation of the 4th joint of peraeopod 3 in particular fits the present specimens exactly. But the hands of gnathopods 1 and 2 are heavier (*cf.* Stebbing's description, 1906). Until the Australian fauna is better known these specimens may quite well be assigned to *rostrata*. Colour (as preserved) pale pink, the peraeon of a deeper shade than the pleon, eyes black.

DISTRIBUTION.—Sooloo Sea and Port Jackson.

Family LEUCOTHOIDAE.

Genus *Leucothoe*, Leach.

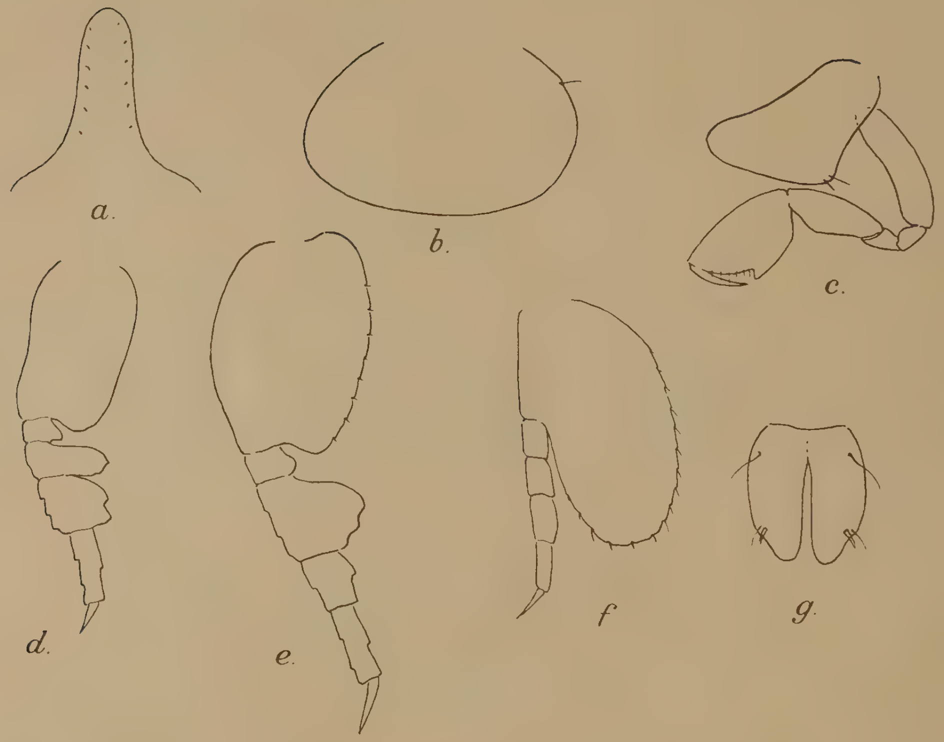
Leucothoe spinicarpa (Abildgaard).

Barnard, 1916, p. 148, and 1930, p. 338.

OCCURRENCE.—St. XVI. From Tunicate, *Polycarpa pedata*, Herdman. 1 ♀, 10 mm.

St. XIX. From a sponge. 1 ♀, 6·5 mm., 1 ovig. ♀, 7 mm.

DISTRIBUTION.—Cosmopolitan.



Text-fig. 1.—*Pontharpinia rostrata* (Dana).—*a.* Dorsal view of rostrum. *b.* Pleon segment 3 *c.* Gnathopod 1. *d, e, f.* Peraeopods 3–5 (spines and setae omitted). *g.* Telson.

Leucothoe furina (Savigny).

Schellenberg, 1928, p. 635.

Occurrence.—St. XIX. From atrial siphon of Tunicate, *Polycarpa aurita* (Sluiter). 2 ♂♂, 7 and 10 mm.

St. XIX. From branchial sac and peribranchial cavity of Tunicate, *Cnemidocarpa irma*, Hartm. 3 ♂♂, 7–8 mm., 1 ♀ with empty brood-sac, 9 mm.

St. XIX. From branchial sac of Tunicate, *Phallusia depressiuscula* (Heller). 1 ♀, 8 mm.

St. XXII. From branchial sac of Tunicate, *Cnemidocarpa irma*, Hartm. 1 ♂, 6 mm., 1 ovig. ♀, 7 mm.

Remarks.—These specimens agree with Schellenberg's account as regards the shape of the postero-inferior angles of pleon segments 2 and 3. In the shape of the hand of gnathopod 2 there is no sexual difference.

Distribution.—Gulf of Suez and Suez Canal, Red Sea, Ceylon, Laccadive Archipelago, Gambier Archipelago.

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Family PARDALISCIDAE.

Genus *Pardalisca*, Krøyer.

Stebbing, 1906, p. 221.

Pardalisca australiensis, n. sp.

OCCURRENCE.—St. 29. 1 ♂, 7·5 mm.

DESCRIPTION.—Very close to *cuspidata*. No dorsal teeth on pleon segment 3, 2 on segment 4, 1 on segment 5. Fingers of gnathopods 1 and 2, and outer plate of maxilla 1 as in *cuspidata*; the latter appendage has 6 dentate spines and 1 seta, and the palp is widened distally, with a spinule in each notch along its distal margin.

REMARKS.—The "Challenger" obtained *P. marionis* at Marion Island, and the "Discovery" collected a new species in the Antarctic. This constitutes the third record of a species of this genus in the Southern Hemisphere.

The posterior half of the body of *marionis* was missing, so a comparison with that species is not possible. The 1st maxilla, however, is much more like Sars's figure of that of *cuspidata* (Sars, 1895, pl cxli) than Stebbing's figure (1888, pl xciv) of that of *marionis*.

Family OEDICEROTIDAE.

Genus *Perioculodes* G. O. Sars.

Perioculodes aequimanus (Kossmann).

Stebbing, 1906, p. 238.
Chilton, 1921, p. 527, fig. 2 (*longimanus*, non Bate & Westw.).
Schellenberg, 1928, p. 641, fig. 200.

OCCURRENCE.—Anchorage, Low Isles. 1 ♂, 1 ♀, 2·5 mm.

REMARKS.—With only two specimens it would not be advisable to regard the specific determination as absolutely certain, though the characters seem to bear out Schellenberg's remarks on the difference of this species from *longimanus* (Bate & Westwood). The antennae also are in harmony with Chilton's figure.

P. megapleon, Giles, *puliciformis*, Giles, and *serra*, Walker, 1904, are probably synonymous; Schellenberg does not refer to *serra*, Walker.

The genus has not hitherto been recorded from the Australasian region.

DISTRIBUTION.—Red Sea, Suez Canal, Chilka Lake, Talé Sap. Probably also Bay of Bengal and Ceylon.

Genus *Oediceroides*, Stebbing.

Oediceroides apicalis, n. sp.

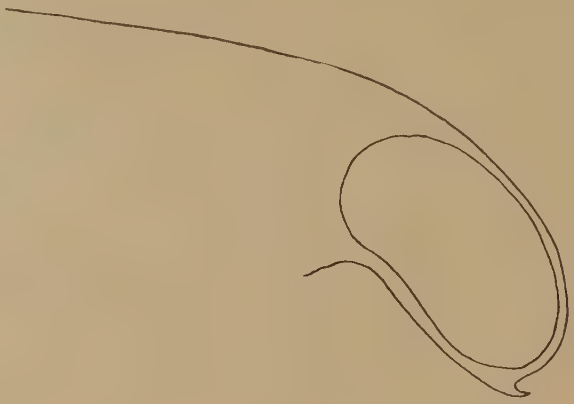
(Fig. 2.)

? Chilton, 1921*a*, p. 66 (*ornatus*, non Stebbing).

OCCURRENCE.—St. 29. 3 ♀♀, 6–9 mm.

DESCRIPTION.—I am inclined to think that these specimens are probably the same as Chilton's single specimen, but not the same as Stebbing's *ornatus* (1888, p. 855, pl. lxiv).

The body appears to be somewhat corrugated, especially in the largest specimen, but the preservation of the specimens is not quite perfect; there do not appear to be any tubercles, thus agreeing with Chilton's specimen. Chilton's description of the rostrum might apply to the present specimens, though he does not state that it is recurved or unciform. This feature, as well as the strongly curved profile of the whole rostrum, clearly separates these specimens from *ornatus*, and is very distinctive.



Text-fig. 2.—*Oediceroides apicalis*, n. sp. Rostrum.

In other respects there are no marked diagnostic features, the gnathopods agreeing with those of *ornatus*. Eyes elongate-oval, contiguous along mid-dorsal line, maroon in colour.

Family Synopiidae.

Genus *Synopia*, Dana.

Synopia ultramarina, Dana.

Barnard, 1930, p. 367.

Occurrence.—St. 21. 2 ♂♂, 2 ♀♀, 3·5–4 mm.

Anchorage, Low Isles, 1.x.28. 45 specimens 2–5 mm., including ♂♂, ovig. ♀♀ and juv.

Anchorage, Low Isles. 20.xi.28. 26 specimens 2–5 mm., ♂♂, ♀♀, juv.

Anchorage, Low Isles. 29.xi.28. 50 specimens 2–5 mm., ♂♂, ♀♀, juv.

Distribution.—Indo-Pacific, tropical Atlantic.

Family Eusiridae.

Genus *Rhachotropis*, S. I. Smith.

Rhachotropis platycera, n. sp.

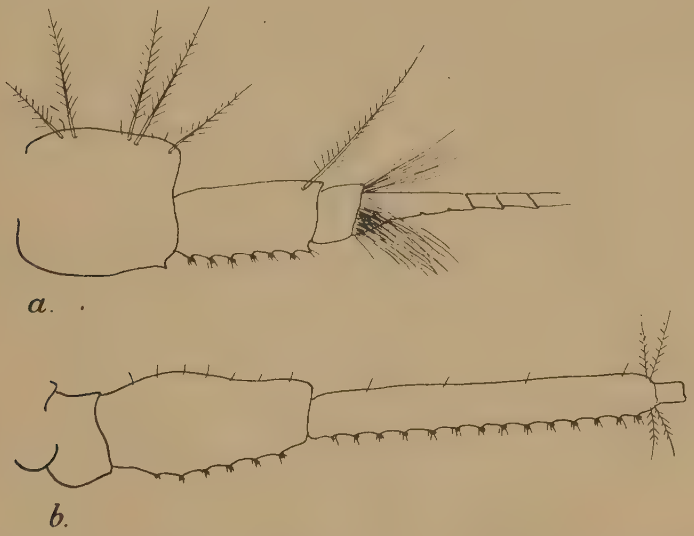
(Fig. 3.)

Occurrence.—St. 29. 3 ♂♂, 1 ♀ (with fully developed brood-sac), 4–4·5 mm.

Description.—Close to *kergueleni*, Stebbing. Eyes well developed, horizontally ovoid, very large, but well separated on top of head, similar in both sexes. Peraeon segment 7 with a medio-dorsal tooth on hind margin, not as large, however, as that on pleon segments 1 and 2. Pleon segments 1 and 2 tricarinate, the keels ending in teeth; segments 3 and 4 with only a medio-dorsal keel, ending in a tooth. Postero-inferior margin of pleon segment 3 serrate. Telson cleft almost to middle.

Peraeopods 3–5, 2nd joint nearly as in *kergueleni*, except that postero-inferior corner is acute only in peraeopod 5.

Antennae 1 and 2, peduncle in male noticeably flattened dorso-ventrally; antenna 1, 1st joint with 5–6 long plumose setae on outer margin, 2nd joint with 1 similar seta on outer apex, inner margin with bundles of short setae, each surrounding a calceolus, 3rd joint very short, bearing on its apical margin, chiefly ventrally, a dense brush of setae, flagellum slender, calceoliferous. Antenna 2, 4th and 5th joints with setules on outer margin, bundles of setae with calceoli on inner margin, the latter with 2 pairs of plumose setae on apex, flagellum slender, calceoliferous. In ♀ antennae similar to those of ♂, but the peduncles are not flattened.



Text-fig. 3.—*Rhachotropis platycera*, n. sp. *a, b.* Dorsal view of left antennae 1 and 2 of ♂.

Remarks.—Although close to *kergueleni* in the structure of the pleon and the basal joints of peraeopods 3–5, this species is at once distinguished by the presence of eyes. They are mart ked noonly by brown pigment, but by a distinct convexity, which, if it had been present in *kergueleni*, could scarcely have escaped Stebbing's notice. The antennae, although somewhat resembling Stebbing's figures (1888, pl. lxxxv), are distinct, especially if the "Challenger" specimens were males (Stebbing does not state the sex). The telson is very much more deeply cleft.

Family GAMMARIDAE.

Genus *Ceradocus*, Costa.

Ceradocus rubromaculatus (Stimpson).

Stebbing, 1906, p. 430.
Schellenberg, 1925, p. 154, and 1928, p. 644

OCCURRENCE.—Low Isles. F8. Shore collection. 10.iv.29. 1 ♂, 7 mm.

Low Isles. F5. Shore collection. 24.iv.29. 1 ♂, 8 mm.; 1 ovig. ♀, 7·5 mm.

REMARKS.—Neither of the males shows any strong teeth on the palms of gnathopod 2.

DISTRIBUTION.—Indo-Pacific, West, South and East Africa.

Genus *Maera*, Leach.

Maera, sp.

OCCURRENCE.—Low Isles. F8. Shore collection. 10.iv.29. 1 ♀, 6 mm.

REMARKS.—It is impossible to assign a single female specimen to any particular species amongst the several which are known from the Australasian region.

Family TALITRIDAE.

Genus *Hyale*, Rathke.

Hyale, sp.

OCCURRENCE.—Low Isles. Shore collection. (E. A. Fraser.) 1 ♂, 7 mm.

Low Isles. Shore collection. Tripneustes Spit. 21.iii.29. 3 ♂♂. 1 ovig. ♀, 5·5–7 mm.

Low Isles. F9. Shore collection. 4.iv.29. 3 mutilated specimens.

REMARKS.—The material is too scanty for specific identification in this difficult genus. Several nominal species are reported from Australian waters.

Family AORIDAE.

Genus *Xenocheira*, Haswell.

In 1906 Stebbing placed this genus in the *Photidae*, although Haswell had referred to its affinities with *Microdeutopus* (*Microdeuteropus*) (Haswell, 'Proc. Linn. Soc. N.S.W.,' vol. x, p. 106, 1885). In 1907 Chevreux ('Mem. Soc. Zool. France,' vol. xx, p. 510) described a second species, and on the basis of the mouth-parts transferred the genus to the *Aoridae* (see also Stebbing, 1910, p. 605).

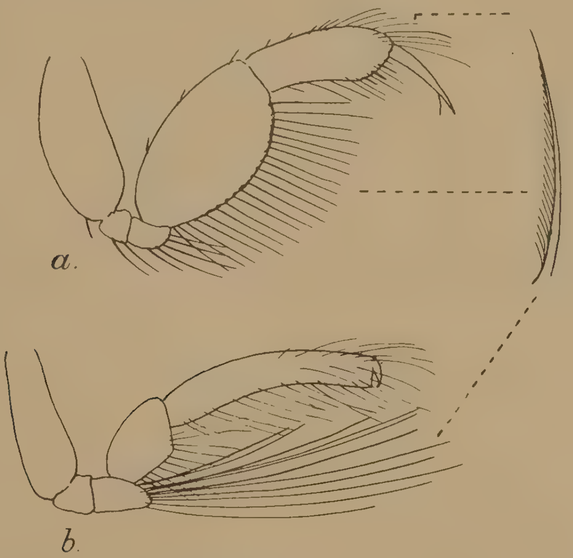
Xenocheira fasciata, Haswell.

(Fig. 4.)

Stebbing, 1906, p. 624.

Occurrence.—Low Isles. Over reef flat. 16.v.29. 1 ♀, 3 mm.

Remarks.—Chevreux (*l. c.*) has given good figures of *seurati*, from which it is clear that the present specimen cannot be identified with that species. There is every reason to assume that it is the same as Haswell's species, and though gnathopods 1 and 2 of the present specimen do not agree with his figures, it is impossible to place much reliance on the accuracy of such crude drawings.



Text-fig. 4.—*Xenocheira fasciata*, Hasw. *a, b.* Gnathopods 1 and 2.

From the figures here given it will be seen that in gnathopod 1 the 5th joint is very stout, both broader and longer than the 6th joint; the latter is scarcely subchelate. Gnathopod 2 is a perfectly normal appendage, the 5th joint not articulating with the 3rd as well as the 4th, but attached to the inner lower surface of the latter. This mode of attachment and the consequent inwardly bent position of the distal joints (more or less transverse across the body) is found in several allied genera (*cf.* Barnard, "Discovery" Report, in press). When such a limb is placed under a cover-slip the tendency is for the distal joints to become twisted. I believe that this is the explanation of the remarkable statement that the 5th articulates with the 3rd as well as the 4th joint.

In the present specimen the 5th joint of gnathopod 2 is not nearly so expanded as in Haswell's figures, or even Chevreux's figure of *seurati*.

When further material is available it will probably be found that not only is there sexual dimorphism in the 1st gnathopod of the adults, but considerable growth changes in the form of both gnathopods.

The species has not been collected in Australia since Haswell's time.

Distribution.—Port Jackson.

Family AMPITHOIDAE.

Genus *Ampithoe*, Leach.

Ampithoe, sp.

OCCURRENCE.—Low Isles. M7. Shore collection. 20.iii.29. 1 mutilated ♀, 7 mm.

REMARKS.—Specific determination of a single female is impossible. The colour as preserved is dull purplish or vinous.

HYPERIIDEA.

Family SCINIDAE.

Genus *Scina*, Prestandrea.

Scina tullbergi (Bovallius).

Stephensen, 1918, p. 129 (*pacifica*).
Wagler, 1926, p. 384, figs. 34, 35.

OCCURRENCE.—St. 19. 1 ♂, 3 mm.
DISTRIBUTION.—Indo-Pacific, Atlantic.

Scina lepisma, Chun.

Wagler, 1926, p. 410, fig. 45, and 1927, p. 107, fig. 13.

OCCURRENCE.—St. 45. 1 specimen in poor condition.
DISTRIBUTION.—Indian Ocean ; tropical Atlantic.

Family VIBILIIDAE.

Genus *Vibilia*, Milne-Edwards.

Vibilia viatrix, Bovallius.

Barnard, 1930, p. 403.
Pirlot, 1930, p. 10.

OCCURRENCE.—St. 2. 1 ♀, 7 mm.
St. 40. 2 ovig. ♀♀, 5·5 mm.

REMARKS.—Colour after preservation in formalin, amber, with dark maroon stellate specks, eyes very dark.

DISTRIBUTION.—Indo-Pacific, Mediterranean, Atlantic.

Vibilia armata, Bovallius.

Barnard, 1930, p. 404.

OCCURRENCE.—St. 24. 1 ♀, 4·5 mm.
St. 28. 1 ♂, 6·5 mm.
DISTRIBUTION.—Indo-Pacific, Mediterranean, Atlantic.

Family PARAPHRONIMIDAE.

Genus *Paraphronima*, Claus.

Paraphronima crassipes, Claus.

Barnard, 1930, p. 409.

OCCURRENCE.—St. 28. 1 ♀, 10 mm.
DISTRIBUTION.—Pacific, Mediterranean, Atlantic.

Family HYPERIIDAE.

Genus *Hyperia*, Latreille.

Hyperia sibaginis, Stebbing.

Stebbing, 1888, p. 1379, pl. clxv (♂).
Pirlot, 1930, p. 18, fig. 6 (♀).
(*Non* Vosseler, 1901 = *Hyperioides longipes.*)

OCCURRENCE.—St. 1. 30 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 2. 24 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 3. 32 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 5. 40 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 6. A lot of ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 7. 36 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 8. 5 adult ♂♂, 6 ♀♀, 2·5–3 mm.
St. 9. A lot of ♂♂, adult and penult. instars, and ♀♀, some ovig., 2–3·5 mm.
St. 10. 19 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 12. 38 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 13. 2 adult ♂♂, 3·5 mm. ; 7 ♀♀, 2–2·5 mm.
St. 15. 32 ♂♂ and ♀♀, 2–3·5 mm.
St. 16. Surface, 10 m., 25 m., 40 m. vert. distr. 4 ♂♂, 11 ♀♀, 2–3·5 mm.
St. 18. 44 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 19. 1 ♂, 2 ♀♀, 3–3·5 mm.
St. 26. 1 ♂, 1 ♀, 3 mm.
St. 27. 11 ♂♂, adult and penult. instars, 10 ♀♀, 3–3·5 mm.
St. 31. 5 ♂♂, adult and penult. instars, 3–3·5 mm.
St. 33. 3 adult ♂♂, 3·5 mm.
St. 34. 4 ♂♂, adult and penult. instars, 3–3·5 mm.
St. 35. 3 ♂♂, 3·5 mm.
St. 37. 8 ♂♂, adult and penult. instars, 3–3·5 mm.
St. 40. 4 ♂♂, 3–3·5 mm.
St. 42. 9 adult ♂♂, 3–3·5 mm., 3 ♀♀, 2–2·5 mm.
St. 44. 3 adult ♂♂, 3–3·5 mm.
St. 45. 2 ♀♀, 3·5 mm.
St. 47. 3 adult ♂♂, 3·5 mm.
St. 48. 8 adult ♂♂, 3·5 mm., 12 ♀♀, 2–2·5 mm.

St. 49 8 ♂♂, adult and penult. instars, and 8 ♀♀, 3–3·5 mm.
St. 50. 6 adult ♂♂, 3·5 mm.
St. 53. 36 ♂♂ and ♀♀, 2–3·5 mm.
St. 54. 13 ♂♂ adult and penult. instars, and 6 ♀♀, 2·5–3·5 mm.
St. 55. 30 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 56. 3 ♂♂, 3·5 mm.
St. 58. 25 ♂♂ and ♀♀, 2–3·5 mm.
St. 59. 6 adult ♂♂, 21 ♀♀, 2–3 mm.
St. 60. A lot of ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 61. 27 ♂♂ and ♀♀, 2–3·5 mm.
St. 63. 10 ♂♂ and ♀♀, 2–3 mm.
St. 66. 8 ♂♂, adult and penult. instars, and 4 ♀♀, 2–3·5 mm.
St. 67. 4 ♂♂, 15 ♀♀, 2·5–3·5 mm.

REMARKS.—As remarked in the " Terra Nova " report (1930, p. 415), the notching of the outer margins of the outer rami of the uropods distinguishes this species from the other species of *Hyperia*.

The species apparently occurs at 0–40 metres ; at St. 19, 45 and 50 closing nets were not used, and there is no evidence to show that the specimens were not caught near the surface. It seems to be generally abundant throughout the year ; males, both adult and in the penultimate instar, and females were caught in all months. It is, however, curious that only one lot (St. 9) contains actually ovigerous females. The date of this haul was August.

DISTRIBUTION.—Philippine Islands, China Sea, East Indies.

Family PHROSINIDAE.

Genus *Primno*, Guerin.

Primno macropa, Guerin.

Barnard, 1930, p. 424.

OCCURRENCE.—St. 20. 1 ♂, penultimate instar, 3·5 mm., 3 ♀♀, 3–4 mm.
St. 45. 1 juv., 4 mm.

DISTRIBUTION.—Indo-Pacific, Mediterranean, Atlantic, Antarctic.

Family LYCAEOPSIDAE.

Genus *Lycaeopsis*, Claus.

Pirlot, 1930, p. 27 (key to species, p. 30).

Lycaeopsis themistoides, Claus.

Barnard, 1930, p. 425.
Pirlot, 1930, p. 27, fig. 8.

OCCURRENCE.—St. 20. 3 ♀♀, 3–4·5 mm.

DISTRIBUTION.—Indo-Pacific, Mediterranean, Atlantic.

Lycaeopsis zamboangae (Stebbing).

Barnard, 1930, p. 426.
Pirlot, 1930, p. 28, fig. 9.

Occurrence.—St. 49. 1 ♂, 4 mm.
Distribution.—Indo-Pacific, Atlantic.

Family Pronoidae.

Genus *Eupronoe*, Claus.

Eupronoe maculata, Claus.

Barnard, 1930, p. 426.
Pirlot, 1930, p. 33.

Occurrence.—St. 11. 1 ♀, 5 mm.
St. 16. 1 juv., 2·5 mm.
St. 22. 1 ♀, 3 mm.
St. 23. 1 ♂, 5 mm.
St. 50. 1 ♂, 3·5 mm.
Distribution.—Indo-Pacific, tropical and subtropical Atlantic, Mediterranean.

Eupronoe laticarpa, Stephensen.

Stephensen, 1925, p. 161, fig. 57.
Pirlot, 1930, p. 35.

Occurrence.—St. 15. 1 ♀, 3 mm.
Remarks.—Like Stephensen's and Pirlot's specimens, this specimen is also a female.
Distribution.—East Indies, Morocco Coast (Atlantic).

Genus *Sympronoe*, Stebbing.

Sympronoe parva (Claus).

Stebbing, 1888, p. 1533, pl. cxcii.
Stephensen, 1925, p. 162, fig. 58.
Pirlot, 1930, p. 32.

Occurrence.—St. 15. 1 ♂, 4·5 mm.
St. 21. 1 ♀, 5·5 mm.
Distribution.—Indo-Pacific, Mediterranean, Atlantic.

Family Lycaeidae.

Genus *Lycaea*, Dana.

Lycaea bajensis, Shoemaker.

Barnard, 1930, p. 431, fig. 60.

Occurrence.—St. 21. 1 ♂, 5 mm.
St. 23. 5 ♂♂, 5 mm., 11 ♀♀, some ovig., 3–4 mm.
St. 24. A lot of ♂♂ up to 5 mm., ♀♀, some ovig., up to 4 mm.
St. 33. 2 ♂♂, 5 mm.
St. 35. 1 ♂, 5 mm., 2 ovig. ♀♀, 3·5–4 mm.

St. 57. 1 ♂, 4 mm., 1 ovig. ♀, 3·5 mm.
St. 58. 1 ♂, 4 mm., 2 ♀♀, 3·5–4 mm.
St. 59. 1 ovig. ♀, 3·5 mm.
St. 60. 1 ♀, 3·5 mm.

Remarks.—Agrees with the specimens assigned to this species in the "Terra Nova" Report. Pirlot (1930, p. 25) thinks that this is the same as *pulex*.

Distribution.—Californian coast, New Zealand.

Family Brachyscelidae.

Genus *Brachyscelus*, Bate.

Brachyscelus globiceps (Claus).

Stebbing, 1888, p. 1555, pl. cxcvii, c (*latipes*).
Stephensen, 1925, p. 176, fig. 65.

Occurrence.—St. 39. 1 ♂, 4·5 mm.
St. 45. 1 ♀, 5 mm.
St. 49. 1 ♀, 4·5 mm.
St. 50. 1 ovig. ♀, 6·5 mm.

Distribution.—Zanzibar, Southern Pacific, Mediterranean.

Family Oxycephalidae.

Genus *Simorhynchotus*, Stebbing.

Simorhynchotus antennarius (Claus).

Barnard, 1930, p. 433.

Occurrence.—St. 4. 1 ♂, 4 mm.
St. 21. 4 ♂♂, 6 mm.
St. 30. 1 ♂, 6 mm.
St. 30a. 1 ovig. ♀, 4·5 mm.
St. 42. 1 ♂, penult. instar, 4 mm.
St. 46. 2 ♂♂, 4·5 mm.
St. 47. 6 ♀♀ (1 ovig.), 3–3·5 mm.
St. 49. 2 ♂♂, 5–5·5 mm.
St. 52. 1 ♂, 4·5 mm.
St. 58. 1 ♂, 5 mm.
St. 66. 1 ♂, penult. instar, 4·5 mm.

Remarks.—Ovigerous females were caught in March and November.

Distribution.—Indo-Pacific, Mediterranean, Atlantic.

Genus *Oxycephalus*, Milne-Edwards.

Oxycephalus clausi, Bovallius.

Barnard, 1930, p. 433.

Occurrence.—St. 28. 1 juv., 6·5 mm.
St. 35. 1 ♀, 14 mm.

Distribution.—Indo-Pacific, Mediterranean, Atlantic.

Genus *Tullbergella*, Bovallius.

Tullbergella cuspidata, Bovallius.

Bovallius, 1890, p. 69, pl. ii, fig. 13, and text-figs. 1, 12, 18, 23, 27, 40, 51, 59, 61, 74.
Colosi, 1918, p. 212.
Spandl, 1927, p. 191, fig. 22.

OCCURRENCE.—St. 2. 1 ♀, 9 mm.
St. 3. 1 ♂, 6 mm., 4 juv., 3–5 mm.
St. 7. 3 ♀♀, 6–8 mm.
St. 10. 3 ♀♀, 5–6 mm.
St. 11. 4 ♀♀, 6–7 mm.
St. 12. 1 ♂, 2 ♀♀, 5–6 mm.
St. 13. 1 ♀, 6 mm.
St. 16. 1 ♂, 5 mm.
St. 17. 1 ♂, 6 mm., 1 ovig. ♀, 7 mm.
St. 23. 1 ovig. ♀, 6 mm.
St. 24. 8 ♂♂, 5–7 mm., 3 ♀♀, 4–5·5 mm.
St. 37. 2 ♀♀, 3·5–4 mm.
St. 40. 1 juv., 3·5 mm.
St. 41. 1 ♀, 5 mm.
St. 46. 1 ♀, 4·5 mm.
St. 51. 1 ♂, 9 mm., 1 ♀, 8 mm., 13 juv., 3–5 mm.
St. 55. 1 ♀, 5·5 mm. ; 6 juv., 3–3·5 mm.
St. 56. 4 ♂♂, 7–10 mm. ; 5 ♀♀ (3 ovig.), 9–10 mm.
St. 57. 1 ♂, 4 mm.
St. 59. 1 ♂, 9 mm. ; 1 ovig. ♀, 10 mm.
St. 60. 1 juv. ♂, 3 mm.
St. 61. 1 juv. ♀, 3 mm. ; 1 ovig. ♀, 8·5 mm.
Low Isles. From subumbrella surface of ? *Cotylorhiza* sp., 10 ♀♀, 6–9 mm.

REMARKS.—Ovigerous females were obtained in the months of May, June, October and November. Colour as preserved, pale horny, in many instances with maroon specks laterally, and along the hind margins of the segments, eyes maroon.

DISTRIBUTION.—Indian Ocean, Siam, Malay Archipelago.

Genus *Glossocephalus*, Bovallius.

Glossocephalus milne-edwardsi, Bovallius.

Walker, 1904, p. 237, pl. i, fig. 2 (*Elsia indica*, Giles).
Colosi, 1918, p. 221.
Stephensen, 1925, p. 202.
Spandl, 1927, p. 196, fig. 24.

OCCURRENCE.—St. 3. 3 ♂♂, 6–9 mm.
St. 11. 1 ovig. ♀, 6 mm.
St. 36. 1 ♂, penult. instar, 4·5 mm.
St. 37. 1 ♀, 4·5 mm.

St. 43. 1 ♂, 7 mm.
St. 46. 3 ♂♂, 8 mm. ; 1 ♀, 6 mm.
St. 47. 1 ♂, 6 mm.
St. 48. 1 ♀, 6 mm.
St. 56. 1 ♀, 5 mm.
St. 66. 1 ♂, penult. instar, 4·5 mm.

Remarks.—Stephensen regards *spiniger* Bov. as a synonym. The present specimens have the hind (lower) margins of the 6th joints of gnathopods 1 and 2 quite smooth.

Distribution.—Indian Ocean, Mediterranean, tropical Atlantic.

Genus *Leptocotis*, Streets.

Leptocotis tenuirostris (Claus).

Barnard, 1930, p. 435.

Occurrence.—St. 19. 1 ♂, 11 mm.

Distribution.—Indo-Pacific, Atlantic.

Genus *Rhabdosoma*, Ad. & White.

Rhabdosoma armatum (Milne-Edwards).

Barnard, 1930, p. 436.

Occurrence.—St. 32. 1 juv., 10 mm.

Distribution.—Tropical Indo-Pacific and Atlantic.

Rhabdosoma whitei, Bate.

Barnard, 1930, p. 436.

Occurrence.—St. 32. 1 ♂, 30 mm.
St. 35. 1 juv. ♂, 15 mm.
St. 36. 1 ovig. ♀, 25 mm. (mutilated).

Remarks.—The ovigerous female lacks the uropods and telson, and consequently the identification may not be correct.

Distribution.—Indo-Pacific, Atlantic.

Family THYROPIDAE.

(PARASCELIDAE, auctt.).

Genus *Parascelus*, Claus.

Parascelus edwardsii, Claus.

Stebbing, 1888, p. 1496, pl. clxxxv.
Stephensen, 1925, p. 211, fig. 83.
Pirlot, 1930, p. 35.

Occurrence.—St. 4. 1 ♂, 6 mm.
St. 8. 1 ♀, 5 mm.

Distribution.—Indo-Pacific, Mediterranean, Atlantic.

Family PLATYSCELIDAE.

Genus *Tetrathyrus*, Claus.

Tetrathyrus forcipatus, Claus.

Barnard, 1930, p. 439.
Pirlot, 1930, p. 42, fig. 11.

OCCURRENCE.—St. 29. 9 ♂♂, 1 ♀ with embryos, 5 mm. (*arafurae*).
St. 32. 8 specimens, 2–3 mm.
St. 40. 2 ovig. ♀♀, 3 mm.
St. 41. 1 specimen, 2 mm.
St. 45. 1 ♂, 5 mm. (*arafurae*).
St. 52. 7 specimens, 2–3 mm.
St. 56. 2 specimens, 3 mm.
St. 59. 2 specimens, 2·5 mm.
St. 67. 1 specimen, 2·5 mm.

REMARKS.—*T. moncoeuri* Stebb. and *arafurae* Stebb. are to be regarded as synonymous. Both typical *forcipatus* and *arafurae* occur in the present collection, the apex of the telson in the latter being markedly truncate, more so than in Pirlot's figure.

DISTRIBUTION.—Red Sea, California, East Indies, East Australia and New Zealand, Mediterranean and tropical Atlantic.

REFERENCES.

(Earlier references will be obtained from the works here cited.)

BARNARD, K. H. 1916. Contributions to the Crustacean Fauna of South Africa: No. 5. Amphipoda. Ann. S. Afr. Mus. XV, pp. 105–302, pls. xxvi–xxviii.
—— 1930. Amphipoda. Brit. Antarct. ("Terra Nova") Exp. 1910, Zool. VIII, pp. 307–454, text-figs. 1–63.
BOVALLIUS, C. 1890. The Oxycephalids. Nova Acta Soc. Sci. upsal. (3), XIV, pp. 1–141, text-figs. 1–87, 7 pls.
CHILTON, C. 1921. Fauna of the Chilka Lake: Amphipoda. Mem. Ind. Mus. V, pp. 519–558, text-figs. 1–12.
—— 1921*a*. Report on the Amphipoda obtained by the F.I.S. "Endeavour" in Australian Seas. Biol. Res. Fish. Exp. V, pp. 31–92, text-figs. 1–16.
COLOSI, G. 1918. Crostacei. III: Oxicefalidi. Racc. planct. "Liguria," II, fasc. 8, pp. 207–225, text-figs. 1–10, 1 pl. Publ. R. Ist. Firenze.
PIRLOT, J. M. 1930. Les Amphipodes de l'Expédition du Siboga. Pt. I. Hyperides. Siboga Exp. Monogr. XXXIIIa, pp. 1–55, text-figs. 1–11.
SCHELLENBERG, A. 1925. Amphipoda. Michaelsen, Beitr. Kennt. Meeresf. Westafr. III, pp. 113–204, text-figs. 1–27.
—— 1928. Amphipoda [Suez Canal]. Trans. Zool. Soc. London, XXII, pp. 633–692, text-figs. 198–209.
SPANDL, H. 1927. Die Hyperiiden der Deutschen Südpolar Expedition, 1901–1903. Deutsch. Südp. Exp. 1901–03, XIX (zool. xi), pp. 147–287, 1 pl. (map), text-figs. 1–63.
STEBBING, T. R. R. 1888. Report on the Amphipoda collected by H.M.S. "Challenger" during the years 1873–1876. Rep. Sci. Res. Voy. "Challenger," Zool. XXIX, pp. 1–1737, pls. i–ccxii, 1 map.
—— 1906. Amphipoda. I: Gammaridea. Das Tierreich, XXI, pp. 1–806, text-figs. 1–127.
—— 1910. Scientific Results of the Trawling Expedition of H.M.S.C. "Thetis." Mem. Austr. Mus. IV, pp. 565–658, pls. xlvii–lx.
STEPHENSON, K. 1918. Hyperiidea. Dan. Ocean. Exp. 1908–1910 to the Mediterranean, No. 5, II, D. 2, pp. 1–70, text-figs. 1–32.
—— 1925. Hyperiidea, part 3. Dan. Ocean. Exp. 1908–1910 to the Mediterranean, No. 9, II, D. 5, pp. 151–252, text-figs. 1–35.
WAGLER, E. 1926. Amphipoda: 2, Scinidae. Wiss. Erg. Deutsch. Tiefsee Exp. "Valdivia," XX, 6, pp. 317–446, text-figs. 1–59.
—— 1927. Die Sciniden der Deutschen südpolar Expedition, 1901–1903. Deutsch. Südp. Exp. XIX (zool. xi), pp. 85–111, text-figs. 1–14.
WALKER, A. O. 1904. On the Amphipoda. Ceylon Pearl Oyster Fisheries, Suppl. Report, XVII, pp. 229–300, 8 pls.

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THE ALCYONARIAN FAMILY XENIIDAE, WITH A REVISION OF THE GENERA AND SPECIES

BY

SYDNEY J. HICKSON, F.R.S.,
Cambridge.

WITH FIVE TEXT-FIGURES AND TWO PLATES

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The Family XENIIDAE.

The Xeniidae form a well-defined family with a combination of characters which distinguish them from all the other Alcyonaria.

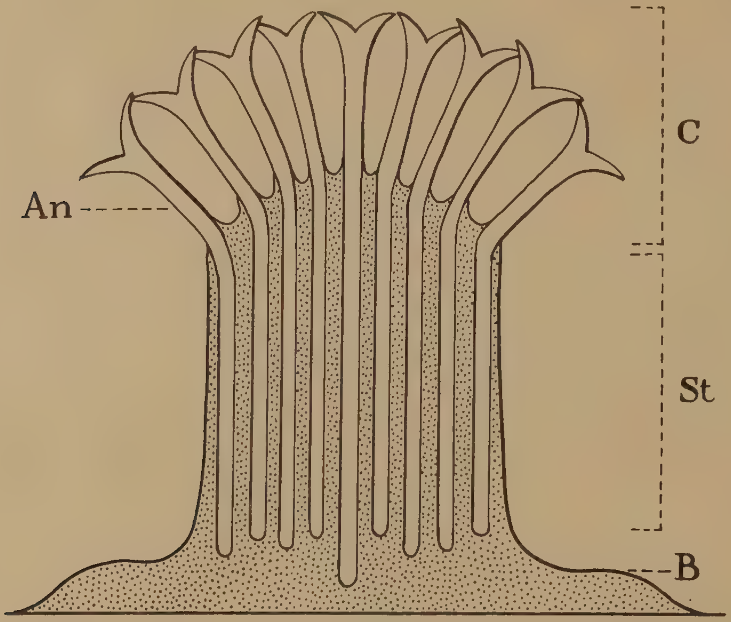
It is difficult to give a precise definition of the family, but the following statement, subject to the explanatory notes which follow, may be taken to indicate the characters by which its members may be identified.

The Xeniidae are soft fleshy Alcyonaria with comparatively slow powers of contractility. The polyps possess only one pair—the dorsal pair—of mesenteric filaments. The tentacles usually possess on each side two, three or more longitudinal rows of pinnules. Calcareous spicules, when present, are minute, round or oval corpuscles, rarely rod-shaped.

Explanation of Some Terms Used in this Paper.—If we examine a specimen of what we may call a typical *Xenia*, we find a base by which the colony is attached to a coral or some other support, which may extend into a thin membranous expansion over the support. From the base rises a smooth and usually cylindrical stalk, terminating above in a dense cluster of polyp heads which I have called the capitulum. In a vertical section it can be seen that the polyp cavities extend from the crown of tentacles through the stalk to the base, or to a considerable depth in the substance of the stalk as in *Alcyonium* and many other Alcyonaria.

Morphologically therefore the polyp consists of an upper free portion—the anthocodia—and a lower portion bound to its fellows by a common coenenchym.

In previous papers the word " polyp " is generally used for the anthocodia only and to avoid misunderstanding I have used it in this sense throughout, but it should be borne in mind that the polyp in this sense is only the free part of the morphological polyp. The stalk, being composed of a bundle of the lower portions of the polyps bound together by coenenchym, is a " syndete " in contrast to the mass of anthocodiae, which I have called the capitulum, and is in Prof. Bourne's (1900) terminology an " apodete."



Text-fig. 1.—Diagram of a Xenia to illustrate the use of some technical terms. *B*, the base of attachment with membranous expansion; *St.*, the stalk or syndete; *C*, the capitulum or apodete; *An.*, the anthocodia of the polyp, usually called the polyp. The basal parts of the polyps are joined together to form the syndete.

Contractility.—Specimens of Xeniidae collected in the ordinary way and sent home in spirit have usually expanded polyps, in contrast with many other Alcyonaria in which the polyps are more or less contracted with their tentacles infolded when preserved.

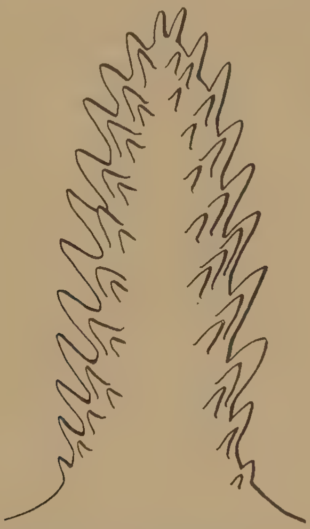
It is true that, with a few exceptions, the polyps are not retracted into the coenenchym nor into the shelter of verrucae, but there can be no doubt that they all possess considerable powers of contraction. The muscular system of the Xeniidae does not differ materially from that of other Alcyonaria, and we have the direct evidence of a few field notes to support the anatomical deduction. Dana (1848, p. 606), for example, wrote that in *Xenia florida* the polyps contract to one-half their full size when taken from the water.

We can form no true conception of the contractility of these Alcyonarians until a great many more accurate and detailed accounts of it are provided by those who have the opportunity to study the Xeniids alive upon the reefs.

The impression the study of preserved material has given me is that the polyps of the Xeniidae contract more slowly than they do in other Alcyonaria.

It is possible that some writers may have been misled by a statement by Saville-Kent (1893, p. 196) that " the component polyps (of *Xenia*) are entirely incapable of contraction." It is probably true that the polyps of many Xenias are entirely incapable of " retraction," but they are all capable of some degree of contraction.

The Mesenteric Filaments.—The absence of the ventral and lateral mesenteric filaments in a species of *Xenia* was first discovered by Ashworth (1898). Since then it has proved to be the most important distinguishing character of the family. I have examined a very large number of specimens of the four genera belonging to the family, and in every case these six filaments were absent. On the other hand they are present, so far as my experience goes, in the full-grown polyps of species belonging to all the other families of the Alcyonaria.



TEXT-FIG. 2.—A diagram of a tentacle of a Xenia to show the arrangement of the pinnules in oblique rows of 3–4 and three longitudinal rows on each side.

The Tentacles.—The typical Alcyonarian tentacle is provided with a single row of pinnules on each side and is said to be " pinnate." In the majority of the Xeniids there are two, three or more rows of pinnules on each side of the tentacles.

It has been shown (Thorpe, 1928, p. 490) that in an early stage in the development of the tentacle there is a single row on each side as in other Alcyonaria but the additional rows are added as the tentacle grows to its full size.

In some cases when the tentacle is fully expanded the pinnules are arranged as represented in the diagram (Text-fig. 2). There are three or four pinnules in a row running obliquely across the tentacle on each side—the oblique rows—and each of these pinnules is a constituent member of a row running longitudinally from the tip of the tentacle to the base—a longitudinal row.

In such an expanded tentacle the pinnules may be all elongated cones in shape, and it is possible that in a healthy expanded living polyp they are always of that shape.

In preserved specimens the pinnules are usually much more unevenly distributed, and it is often very difficult to count the number in the oblique and longitudinal rows with accuracy. They have frequently the appearance of being quite irregularly scattered over the oral surface of the tentacles.

Moreover, in many of the preserved specimens either the whole of the pinnules or those of the inner longitudinal rows are contracted into the form of warts or low mounds. This matter, however, is discussed more fully in a subsequent section (p. 146).

Spicules.—I think there can be no doubt that some Xeniidae are entirely devoid of spicules; but, when present, they are always in the form of minute round or oval discs, or more rarely thin rods. The spindles, needles, capstans and other forms of spicules which are so common in other groups of Alcyonaria are never found in this family. In the Pennatulid *Scytalium* small disc-shaped spicules 0·05 mm. in diameter are found, but in other families they are very rare.

Another point of great interest about these spicules is their remarkable uniformity in size. With a few exceptions these spicules range from 0·02–0·025 mm. in diameter.

In some species there may be spicules a little above or below these figures, but what is very striking is that when a large number of specimens from the tropical seas are examined, the variation in the size of the spicules is so small. A remarkable exception is found in *Cespitularia mantoni*, where the round disc-shaped spicules are 0·1 mm. in diameter, that is to say four times the diameter of the spicules of all the other specimens of Xeniidae from the Barrier Reef that I have examined (Text-fig. 5, p. 168).

Colour.—Many naturalists have described the delicate colour of the living Xenias, but at present it is not possible to make use of the colour characters in systematic work. Moreover, the chemical and physiological natures of these colours, which are soluble in spirit, are entirely unknown.

The most prevalent colour is pale blue, "a porcelain or electric blue" according to Saville Kent. Crossland, in a private letter, has told me that in Zanzibar he saw many blue Xenias. Several of the specimens described in this paper were labelled "blue." On the other hand many references to other colours will be found in the literature. Saville Kent, for example, gives coloured illustrations of Xenias that are "beryl green," pink, yellow and slate coloured, and Yonge describes a delicate dove-grey *Xenia* on Pixie Reef (1931, p. 140).

It seems very probable that, as with our own common sea-anemones, the colours of the species are very variable. The case of *Cespitularia coerulea* of Zanzibar lends strong support to this view. May (1900, p. 90) described the species as flesh-coloured with a tinge of bright blue. Crossland described the colours of three specimens of the same species, identified by Thomson and Henderson (1906, p. 415), as (1) "brilliant sea green," (2) "pink stems," (3) "pink body with blue-green zooids."

Gonads.—It would be of great interest if we possessed some knowledge of the time of spawning of the different species of the Xeniidae. If they all spawn at the same time some of the varieties may be hybrids; if, on the other hand, there is an interval of one or more months between the sexual periods of the different species hybridization would be checked or prevented. On this point our knowledge is so scanty that it offers no solution for the problem.

The following notes on the presence of gonads in the dated specimens I have examined may be of some value for future investigators:

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All the specimens with gonads were dioecious. There was no evidence of hermaphroditism at any stage. Unfortunately most of the specimens showed no gonads when examined with a lens, and it may be inferred therefore that they were not nearly ripe sexually. *Heteroxenia elisabethae* collected at the end of May had female gonads 0·75 mm. in diameter. *Cespitularia mantoni* collected in July had small male gonads 0·15 mm. in diameter, and a specimen of *Xenia plicata* collected in August to September had small female gonads 0·2 mm. in diameter.

All the other specimens were collected either in April or May and showed no gonads.

On Dimorphism in the Xeniidae.

The question of the dimorphism of *Heteroxenia* has been a subject of controversy for some years, and there can be no doubt that the correct interpretation of the facts in this case must have an important effect on the classification which should be adopted. Briefly stated the problem is as follows :

Is there a true anatomical and physiological dimorphism of the zooids in *Heteroxenia elisabethae* and some other species ; and if so, is the dimorphism of generic importance ?

Kölliker (1874) was the first to describe as dimorphic a specimen from Port Denison, in Queensland, which he named *Heteroxenia elisabethae.* He pointed out important differences in structure between the siphonozooids and the autozooids.

Haacke (1886), from an examination of specimens of the same species from Torres Straits, came to the conclusion that the siphonozooids are only young autozooid buds and that, therefore, there is no true dimorphism in the species.

May (1900) examined specimens from Zanzibar which he considered to belong to the same species and gave support to Haacke's opinion. May, however, studied the structure of the zooids more carefully, and pointed out a difference between the siphonozooids, which have incurled tentacles, and the young autozooids, which never have their tentacles incurled. As he did not discover any other difference between them he considered that they are not morphologically distinct. His contention that these zooids cannot be true siphonozooids because they bear rudimentary tentacles was not sound, as a tentacle occurs on some of the siphonozooids in the Pennatulacea (Marshall, 1883, and Kükenthal and Broch, 1911).

When May published his paper he had not seen, apparently, Ashworth's account of the same species from Zanzibar which appeared in the previous year.

Ashworth's examination of the zooids was much more thorough than May's. He found a constant difference in structure between the siphonozooids and young autozooids of 2 mm. or more in length, and that the young autozooids bear sexual cells and the siphonozooids do not.

Ashworth agreed therefore with Kölliker and Bourne (1895) that *Heteroxenia elisabethae* is truly dimorphic.

Kükenthal (1902) agreed with May that the genus *Heteroxenia* should be suppressed, and he classified *H. elisabethae* and some other dimorphic species with the species of *Xenia*, but accepted the view that dimorphism does occur in the Xeniidae in a form not very sharply defined. ("Einige Arten mit wenig ausgeprägten Dimorphismus der Polypen.")

Two years later (1904) Kükenthal published a paper in which he described under the name *X. fuscescens* a number of specimens collected by Dr. Hartmeyer principally near Tor, off the Sinai peninsula. He said that in this species there is great variability ; there are examples without dimorphism, examples with pronounced dimorphism, and between them intermediate forms (p. 38). There are also some with spicules and some without spicules. The absence of spicules and the pale transparent colour seemed to be correlated with the absence of dimorphism, the dimorphic forms being darker in colour and provided with abundance of spicules. In 1911 Kükenthal's pupil Cylkowski wrote a dissertation on the dimorphism of the Alcyonaria, in which he described his investigation of thirteen specimens of this species from Jidda in the Red Sea. Four of these specimens were dimorphic, the others were not dimorphic. No mention is made of any intermediate forms beyond the statement that one small branch of a dimorphic form was not dimorphic (p. 12).

The presence of dimorphism is not a question of size; according to Cylkowski, there are both large and small specimens with siphonozooids, and there is no other difference between the dimorphic and monomorphic forms except in the greater extent of the superficial canal system in the former.

Cylkowski confirms Ashworth's statements concerning the relative sizes of the siphonozooids and the young autozooids at the margin of the colony, but says that elsewhere there are intermediate forms which may be siphonozooids in the process of being converted into autozooids, and comes to the conclusion (p. 16) that the siphonozooids are nothing else than developmental stages of the autozooids.

It is noteworthy that no one has yet been able to confirm Kükenthal's statement that there are intermediate forms between those that are dimorphic and those that are not. Thomson and Henderson (1906) and Light (1915), who examined large numbers of Xeniids, found no difficulty in separating the two forms, and I can confirm this from a study of the large collection of specimens I have examined. In my opinion a Xeniid is either dimorphic or it is not; there are variations in the relative numbers of autozooids and siphonozooids, and it is possible that a single small branch of a dimorphic colony may not show any siphonozooids, as in Cylkowski's specimen, although I have not seen one showing this feature, but there is no "beginning of dimorphism," and no intermediate forms between the two. The dimorphism is an established physiological condition in this genus.

The question of the dimorphism in *Heteroxenia elisabethae* seemed to have been definitely settled when Ashworth published his paper in 1899. He showed conclusively that the siphonozooids can be distinguished from the young autozooids of the same height by the size and condition of the tentacles and other characters. He gave the figures of a number of measurements of the two forms, and gave some excellent drawings to illustrate his descriptions (see his pl. 27, figs. 38 and 39).

No serious attempt was made to dispute Ashworth's observations and morphological conclusions until Cylkowski wrote his thesis in 1911. Unfortunately this very interesting paper is not easy to obtain; but thanks to the friendly offices of Prof. Pax I have been able to borrow a copy of the text, without the illustrations, from the library in Breslau.

In most respects Cylkowski confirms Ashworth's results, and indeed emphasizes the difference between the elaboration of the superficial canal system in the dimorphic forms as compared with the monomorphic forms, but states that except at the margin of the capitulum the siphonozooids and the young stages of the autozooids are indistinguishable.

As this is a point of considerable importance I have most carefully examined the specimen from the Barrier Reef and cannot confirm Cylkowski's result in this respect. Young autozooids and siphonozooids of the same length are quite distinct throughout the whole capitulum. The former can be distinguished from the latter by their greater size, by the presence of pinnules on the tentacles and by the presence of gonads in the coelenteric cavities.

It must be remembered, however, that Cylkowski was working on material from the Red Sea, and it is possible that the difference in our results may be due to a difference in the species that were investigated.

In the controversy on the morphological distinction of the two kinds of zooids, very little attention has been paid to the possible physiological distinction between them.

In other dimorphic Alcyonaria the siphonozooids, having no tentacles and no digestive gland-cells either in the stomodaeum or in the mesenteric filaments, are not digestive zooids; on the other hand, their relatively large siphonoglyph and the retention (usually) of the dorsal mesenteric filaments suggest very forcibly that their main function is to maintain a flow of water throughout the coenenchym. The physiological distinction as regards nutrition is further emphasized in other Alcyonaria by the presence of the six digestive ventral and lateral mesenteric filaments in the autozooids and the absence of these filaments in the siphonozooids.

As Ashworth (1898) was the first to point out, the zooids of the Xeniidae possess no ventral and lateral mesenteric filaments, and in that respect a well-marked morphological distinction between autozooids and siphonozooids does not occur. As compensation for the absence of these mesenteric filaments, however, the stomodaeum of the zooids in this family is remarkably long and the epithelium bears numerous gland-cells, which are probably digestive in functions.

In order to throw some further light on the physiological function of the zooids of *H. elisabethae*, I have examined series of sections through the autozooids and siphonozooids of the very well-preserved specimens from the Barrier Reef.

In 1883 (p. 696), before the days of the modern technique for serial section-cutting, I made the statement that there is no siphonoglyph in the stomodaeum of the autozooids of this species. This was an error, which was corrected later by Ashworth (1899, p. 290). There is a siphonoglyph in the autozooids but it is not so pronounced as it is in the siphonozooids, and in the upper part of the stomodaeum fades away until its epithelium is hardly distinguishable from the epithelium of the rest of the stomodaeum. The mistake I made in my original statement may have been due to the examination of a few sections of the upper part of the stomodaeum in less well preserved material.

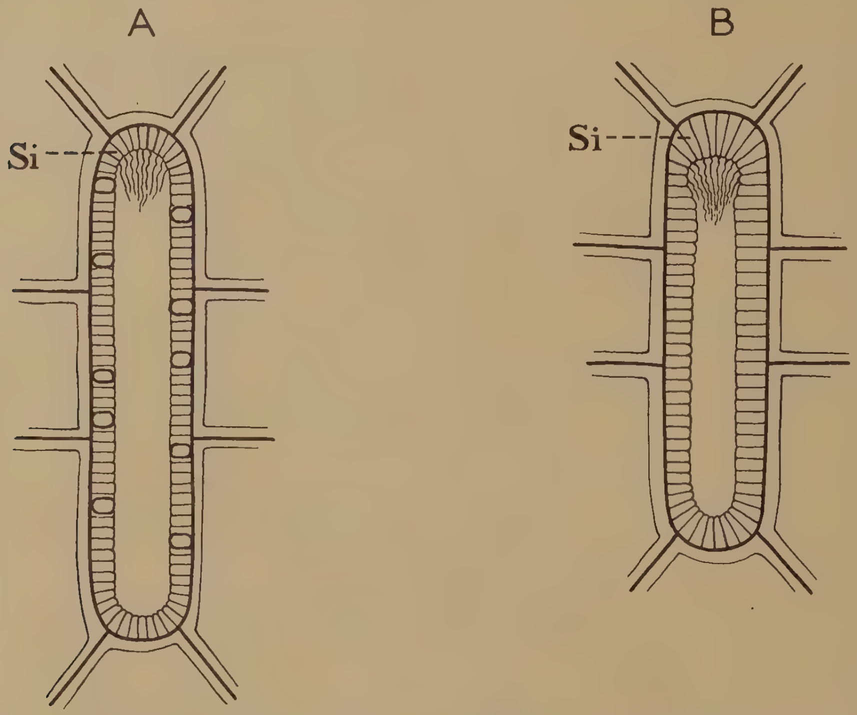
It may be noted here that according to Kükenthal (1906, p. 23) there is no siphonoglyph in the autozooids of *Heteroxenia uniserta*.

A careful study of series of sections through the whole stomodaeum of both autozooids and siphonozooids of a well-preserved specimen of *H. elisabethae* from the Barrier Reef has led to the following results:

The length of the stomodaeum of the autozooids, according to my measurements, is 3·5 mm. and of the siphonozooids 0·3 mm.

Ashworth (1899, p. 289), working on a specimen from Zanzibar, gave the length of the stomodaeum of the autozooids as 1·15 mm. and of the siphonozooids 0·6–0·8 mm. The discrepancy between the two sets of measurements may be partly accounted for by the fact that in my specimen the stomodaeum was straight and in Ashworth's it was wrinkled and folded transversely. In both specimens, however, the stomodaeum of the autozooid is much longer than it is in the siphonozooid.

When seen in transverse section the stomodaeum of the siphonozooid appears as a flattened tube 0·2 mm. in greater, 0·055 mm. in lesser diameter (Text-fig. 3). It is lined internally by an epithelium 0·015 mm. in height, but this epithelium becomes thickened to 0·025 mm. in the ventral corner, *i. e.* at the siphonoglyph. The epithelium of the siphonoglyph is not only thicker, but the cells are more crowded together and the nuclei more numerous than they are elsewhere. The cells of the siphonoglyph bear long cilia which are well preserved in the specimen (Text-fig. 4). The cells of the other parts of the epithelium may also be ciliated, but if present these cilia must be small and are not clearly preserved. The breadth of the siphonoglyph (as seen in transverse section) is approximately 0·03 mm.

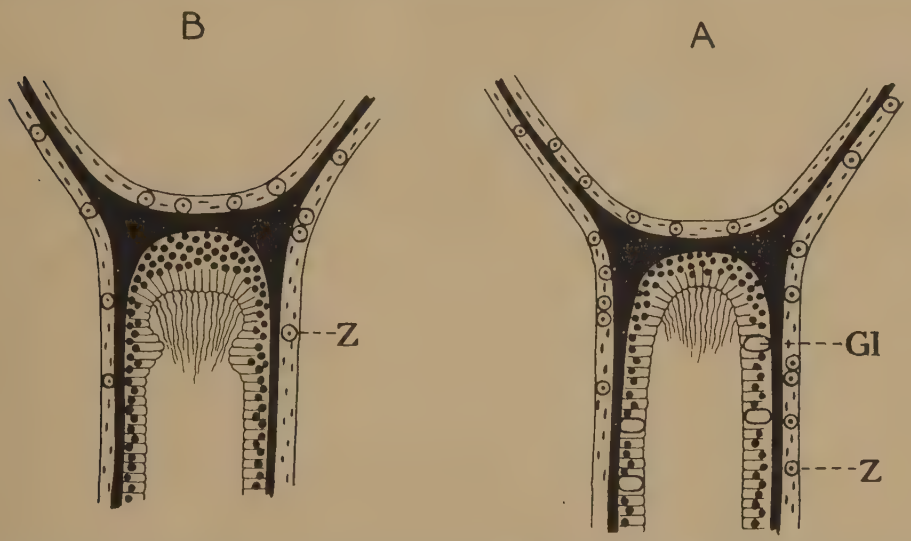


Text-fig. 3.—Transverse sections through the stomodaeum of a, an autozooid, and b, a siphonozooid of *Heteroxenia elisabethae* to show the relative proportions of the siphonoglyph (*Si.*) to the rest of the epithelium. a × 100 diams. b × 200 diams.

In a transverse section of an autozooid the stomodaeum is seen to be more or less folded, but it may be flattened in places as in the stomodaeum of the siphonozooid. The greater diameter of the stomodaeum thus flattened is about 0·5 mm. The epithelium throughout is 0·015 mm. in thickness. In the region of the siphonoglyph the increase in thickness of the epithelium is inappreciable, and the cells do not appear to be much more crowded than elsewhere. But the siphonoglyph is distinguished by bearing a tuft of long cilia as in the siphonozooid.

Taking these figures as approximately accurate, I have reckoned that the proportion of siphonoglyph epithelium to general epithelium, as seen in transverse section, is in the autozooid 1 : 16 and in the siphonozooid 1 : 7. If these figures were to be multiplied by the lengths of the stomodaea of the zooids respectively so as to obtain the superficial areas of the siphonoglyphs and of the general epithelium the contrast would be very greatly increased. This cannot be done at present, as I have found it impossible to determine with any degree of accuracy the length of the siphonoglyph in the two zooids. It is indistinguishable in the upper part of the stomodaeum in the autozooid, and apparently extends throughout its whole length in the siphonozooid.

The structure of the stomodaea of the two forms seems, then, to prove almost conclusively that the siphonoglyph of the siphonozooid is relatively a much more important organ for maintaining a flow of water than it is in the autozooid. Moreover, as in other Xeniid polyps, the epithelium of the stomodaeum of the autozooid bears numerous gland-cells (Text-figs. 3 and 4); in that of the siphonozooid there are none. The siphonozooids, therefore, play no part in catching or digesting food, and their sole function, so far as we can judge, is to produce by the ciliary action of the siphonoglyph a constant flow of water into the canal system of the coenenchym, which the absence of gonads in the coelenteric cavities facilitates.



Text-fig. 4.—Transverse section through the ventral side of the stomodaeum of A, an autozooid, and B, a siphonozooid, of *Heteroxenia elisabethae* to show the further details of the structure of the siphonoglyph. *Gl.*, gland-cell in the autozooid; *z.*, zooxanthellae in the endoderm.

Haacke, in his account of *Heteroxenia elisabethae* from Torres Straits, said that the siphonozooids are not " professionelle Wasserpumpen." The evidence clearly proves that they are professional water-pumps.

Two other species, *H. capensis* and *H. uniserta*, are unquestionably dimorphic, and another, *H. rigida*, is probably dimorphic. (For the characters of these species see pp. 172, 173.)

The only question that remains, therefore, is whether we are justified in collecting the species of the Xeniidae which exhibit dimorphism into a separate genus. The character is one which can be determined at a glance ; there is never any difficulty in deciding whether a specimen is dimorphic or not. It would therefore be convenient to the systematist to keep them distinct, but apart from that consideration, the morphological investigation of the structure of these species shows that such a separation is scientifically sound.

This conclusion is confirmed by the facts of distribution. In all the localities in which *H. elisabethae* has been found, the Barrier Reef, the Philippines, Zanzibar and the Red Sea, monomorphic species occur living under similar conditions and environment. If dimorphism were due to any extraordinary or special conditions of life, the dimorphic form might be regarded as a variety of a similar monomorphic form specially adapted to survive under these conditions, but as they live side by side on the reefs and do not, so far as we know, give rise to intermediate or hybrid forms, the conclusion that they are quite distinct genetically seems to be inevitable.

The Species Problem in Xenia.—The difficulty of dividing the specimens of *Xenia* into definite specific groups is greatly increased, not diminished, as the numbers examined increase. The discontinuity which seems to occur when only a few odd specimens are studied dwindles and disappears until an almost complete continuity between many of the extreme forms is revealed.

Such an opinion would not have been expressed on the examination of the collection of Xeniids from the Barrier reef alone, rich as it is ; but only after a comparison of them with a large collection from many other localities. It has been my good fortune to be able to examine specimens from the Red Sea, Zanzibar, Diego Garcia, the Maldives, Ceylon, Celebes, Torres Straits, New Britain, Tonga, Fiji and Funafuti, and I have made preparations for the study of the tentacles, spicules and other characters of nearly all of them.

The conclusion I have arrived at is that the keys which have been proposed by Ashworth (1900), May (1900) and Kükenthal (1902), being based on characters which now appear to be very variable, are really of very little value, and that there is a need for a revision of the species of *Xenia.* The remarks that follow, however, have some application to the other genera of the family, and are therefore included in this section.

The principal characters used in the keys are the shape of the pinnules, and the number of them in the oblique and longitudinal rows. If it could be proved that the various shapes of pinnules that are seen in preserved specimens correspond with their shapes when the Xeniids are alive, and that no material change takes place when they are exposed to the sun in shallow water at low tide or when plunged into formalin or spirit, the shape of the pinnules might be of some systematic value. This assumption, however, does not appear to be sound.

The evidence that these Alcyonarians are to some extent contractile is conclusive, and in all probability the pinnules are among the first parts of the polyps to undergo some withdrawal. The number of pinnules in the rows is also assumed in these keys to be a constant character. A statement is often made in the description of a species that the number of pinnules in an oblique row is three or in another species four, as if this was a definite character for all the polyps of the colony. The careful study of a large number of tentacles of any specimen shows, however, that there is considerable variation in this respect with the species having more than two in a row. Tentacles with 3, 4 or even 5 in an oblique row may be found in one colony (see *H. elisabethae*, p. 171).

I have not found any Xeniid with two pinnules in an oblique row on each side, such as *X. ternatana* is said to have, but I doubt whether they are less variable in that species. Several examples are quoted in the following pages in which the numbers of rows of pinnules are said by previous authors to be variable, and I have found some variation in this respect in nearly all the specimens I have examined.

The shape of the pinnules (pointed cones, blunt cones, warts, mounds, etc.) of preserved specimens is a character due in large measure to the degree of contraction in or before preservation, and is certainly very unreliable for making specific distinctions. Different parts of the same colony often differ very materially as regards the shape of the pinnules. A most striking example of this is described in a specimen of *X. crassa* (p. 160).

Several cases have been quoted of species with pinnules on both sides or all round the tentacles (*e. g. X. bauiana* and *X. medusoides* by May and *X. depressa* by Kükenthal). It is noteworthy that in all these cases the polyps belonged to old Museum specimens. I had not seen any example of it until my attention was called to a specimen collected by Dr. A. C. Haddon, to which a note was attached " dry on arrival." In this specimen several of the tentacles showed wart-like pinnules on both sides.

Unless there is some strong evidence to the contrary derived from the observation of living Xenias or from really well-preserved specimens, this character must be regarded as a result of post-mortem shrivelling.

Kükenthal (1914, p. 6), in the last paper he wrote on the Xeniidae, came to the conclusion that the characters based on the shape and numbers of the pinnules are unsatisfactory for systematic purposes, pointing out that the numbers of rows are often very difficult to count, and that the shape of the pinnules is often due to contraction. With these conclusions I am in full agreement.

If we abandon the use of the tentacles as affording reliable characters for the definition of species, there is nothing left that would help in the formation of a scientific key to the species.

The characters of the stalk are so variable, and seem to be so dependent on the surface of the support and the presence of immediate neighbours, that it has no value.

The spicules in a few cases (*e.g. Cespitularia mantoni*) give examples of discontinuity, but in the great majority of Xeniidae are so uniform in shape, size and variability that they afford no reliable help for distinguishing species.

As regards other anatomical features, such as the mesenteric filaments, stomodaeum canal system, etc., all that can be said at present is that series of sections through several colonies from different localities have revealed a uniformity of structure which gives no clue to any differentiation of species.

It seems probable that the deep-water forms *X. crosslandi*, *X. antarctica* and *X. wandeli* do represent discontinuous groups and are therefore true species.

As regards the forms which are found in shallow water in the Red Sea, Indian Ocean, Malay Archipelago and the Pacific Ocean, there seems to be a continuous series from the forms with large polyps 20–30 mm. in length (*X. elongata*) to those with very small polyps 1 mm. in length (*X. nana*).

It would be quite reasonable to regard them all as varieties of one widespread species adaptable to the very varied environments of warm, shallow sea-waters.

But to give them all one specific name would obviously be inconvenient, and possibly premature.

I have therefore adopted a system based partly on the size of the polyps and partly on geographical distribution—a system which is frankly artificial, but may be convenient as a temporary measure.

Three well-defined genera can be recognized—

1. *Xenia*, with monomorphic polyps. Margin of the capitulum well defined. Stalk, when present, simple or slightly branched, and free from anthocodiae.
2. *Cespitularia*, with monomorphic polyps. Margin of the capitula not well defined. Dendritic or lobate in growth. Stalk and branches with small scattered anthocodiae.
3. *Heteroxenia*, with dimorphic polyps.
4. *Sympodium*. As the species included in the genus *Sympodium* may be only young growth stages of species of *Xenia* there is some doubt as to its validity. The polyps in these forms do not form a syndete but arise independently from a membranous base. Some notes on *Sympodium* are given at the end of this paper (p. 174).

My thanks are due to Prof. Stanley Gardiner for giving me facilities to work in the Zoological Department in Cambridge, to Prof. Pax, of Breslau, for the loan of a copy of Cylkowski's dissertation, to Prof. Ashworth for the loan of an unpublished manuscript on the Dimorphism of *Heteroxenia*, and to several members of the Expedition for information concerning the living Xenias.

The Genus XENIA, *Lamarck*.

It is not necessary to give an account of the very complicated history of this genus. Those who are interested in the subject will find a list of references in the papers by Kükenthal (1902) and previous authors.

There can be no doubt that the Alcyonarian described in MS. by Savigny and published by Lamarck in 1816 was a *Xenia*, and that the type-species of the genus is *X. umbellata*. Since that time a very large number of species have been mentioned or described as species of this genus. Some of these, such as *X. caribaeorum* (D. & M.), are not related to the genus at all (see Kükenthal, 1902, p. 660), and others have been so inadequately described that they cannot be recognized. There remain about 30 species, excluding those which are now referred to *Heteroxenia*, which have been well or moderately well described.

In addition to these there are about a dozen species attributed to other genera, *e. g.* *Anthelia*, *Sympodium* and *Clavularia* which may be only young growth stages of certain Xenias.

Kükenthal's (1902) definition of the genus was as follows:

> "Mit sterilem einfachem oder getheiltem Stamm und scharf davon abgesetzter Endscheibe. Bei einigen Arten beginnender Dimorphismus der Polypen. Siphonozooide mit Tentakeln aber ohne Pinnulae."

This definition has to be modified as a consequence of more recent researches on the genus.

In the first place there are many specimens which undoubtedly belong to the genus which have no stalk, and in the second place the dimorphic species must now definitely be relegated to the distinct genus *Heteroxenia* (see p. 141).

A revised definition of the genus may read as follows:

Colonies monomorphic. Polyps (*i. e.* the anthocodiae of the polyps) not retractile. Stalk, when present, sharply differentiated from the capitulum, unbranched, or if branched the branches simple and of approximately the same length.

There is never any difficulty in determining whether any specimen of this family is or is not dimorphic. The only species about the dimorphism of which there has been any controversy is *Heteroxenia elisabethae* (see p. 141). In the literature of the subject there is no mention of dimorphism—nor of "the beginning of dimorphism"—in any of the species mentioned in the following lists, and a careful search for any signs of dimorphism in all the specimens of these species I have examined has proved that the colonies are simply monomorphic.

There are no species included in the genus in which the anthocodiae of the polyps are retracted into verrucae or below the general surface of the coenenchym. In this respect they differ from species attributed to the genus *Cespitularia*. But the anthocodiae are to some extent contractile, and in preserved specimens various degrees of contraction may be seen in the body-wall, the tentacles and in the pinnules. In many specimens which undoubtedly belong to the genus *Xenia* there is no stalk—that is to say, the colony is more or less planoconvex in section and the anthocodiae project from the whole of the convex surface.

It is possible, or even probable, that at a later stage of growth these specimens would have developed a stalk, but they must be included in the genus even if it is the case that they never develop this character.

The stalk, when present, is thick and either simple or in some cases divided into a few short branches, but the capitula at the ends of these branches are so close set that the colony appears to have only one capitulum. In *Cespitularia* the branches are discrete. (Plate II, fig. 6).

There can be little doubt that in some Xenias there are no spicules, but when they are present they are thin discs or ovals having a maximum diameter of 0·018–0·025 mm. In some cases rods and twins occur with the common types, but the shape of the spicules is so variable that they are rarely of any value for specific diagnosis. A point of some interest about them, however, is that they are very rarely over 0·025 mm. or less than 0·018 mm. in diameter. The largest I have seen are curiously enough in the very small specimens of *X. nana* (Hickson, 1931), where the twins are 0·05 mm. in length.

Geographical Distribution.—The genus has a wide distribution in shallow tropical seas, extending from the Red Sea through the Indian Ocean, Malay Archipelago and Australian Barrier Reef to the western half of the Pacific Ocean. Kükenthal's *X. antarctica* was found in 457 metres off Bouvet Island, and Jungersen's *Ceratocaulon wandeli*, which is probably a *Xenia*, was found in 538 metres in the Arctic Sea N. 66° 16′, W. 25° 20′.

No species of the genus have been found in the Atlantic Ocean nor in the Pacific Ocean east of longitude 180°, unless the *Sarcothela edmondsoni* (Verrill, 1928) of Hawaii proves to be a *Xenia*.

From the shallow waters off the coast of Zanzibar ten species have been described as distinct, from Ternate eight species, and from various localities in the Pacific Ocean nine species.

In many cases a new species has been named on the description of only one or two specimens from a locality and on characters which we know now are extremely variable, and there can be no doubt that if such characters are used in the same way for specific diagnosis, the number of species of the genus will be extended indefinitely.

The work of the past is not to be regretted because the description of a new species is almost invariably more detailed and better illustrated than the description of a specimen referred to an established species. We have at least learned a great deal by this process of the variations within the genus. But it is incredible that in the shallow waters of the coast of Zanzibar, for example, there are ten true Linnean species. Some may be only young growth stages, some varieties due to purely local conditions, and others may possibly be hybrids.

It may be premature to act upon the belief that specific differentiation does not exist in the genus, or that there is only one very variable species in the world, but some reduction in the number of recognized species must be made unless the systematics of the genus are to be thrown into absolute confusion.

It may be most convenient to deal with this matter geographically in the first instance.

Red Sea.—Three species have been described from the Red Sea: *X. umbellata*, *X. fuscescens* and *X. coerulea*. The monomorphic forms of *X. fuscescens* are so closely allied to *X. umbellata* that it is impossible to separate them (see p. 173), and as Thomson and MacQueen (1908, p. 51, footnote) remark, "it seems certain that *X. umbellata*, *X. fuscescens* and *X. coerulea* are very closely related. It may be necessary eventually to unite them in one variable species."

To these species May (1900, p. 81) added *X. blumi* (Suez) and Kükenthal (1913) *X. ternatana* (Jedda) and *X. hicksoni* (Massowa) as inhabitants of the Red Sea. Kükenthal's two specimens of *X. hicksoni* differ from the type in having much bigger polyps and smaller spicules. The description is not very full, and the specimens may be only a variety of *X. umbellata*.

Zanzibar.—The following species have been recorded:

X. umbellata.
X. tumbatuana.
X. quinqueserta.
X. sansibariana.
X. bauiana.
X. medusoides.
X. coerulea.
X. membranacea.
X. ternatana.
X. crosslandi (*rigida*).

In *X. bauiana*, according to May (1900, p. 77), there are three rows of pinnules on each side of the middle line on both sides of the tentacles. *Xenia quinqueserta* and *X. sansibariana* are evidently closely related, from May's original account, the only difference between them being that the pinnules are thick and blunt in the former and long and pointed in the latter. They are both said to possess five rows of pinnules, but in a specimen attributed to *X. quinqueserta* by Thomson and Henderson (1906) there are said to be three to five rows of pinnules, and these authors remark, "we suspect that both may be varieties of *X. umbellata.*"

X. tumbatuana (May) seems to me a very doubtful species. It has three rows of thick blunt pinnules on the tentacles, but in other respects does not differ materially from the other two species.

No spicules were found in any of the three species mentioned above.

X. medusoides (May, 1900, p. 88) was described from two specimens in the Hamburg Museum. The only distinguishing feature of this species is that the pinnules are arranged all round the slender axis of the tentacles. I have frequently found this condition in shrivelled, badly-preserved specimens, and it is difficult to believe that it is anything but an artefact. This view is confirmed by the description (by Kükenthal, 1902, p. 656) of another specimen in the Stuttgart Museum in which the pinnules were strongly contracted. The only case in which I have observed rows of pinnules on the aboral side of tentacles that are apparently fully expanded is that of *X. garciae.*

X. membranacea was first described by Schenk (1897, p. 57) from Ternate, and specimens were afterwards attributed to the species by Ashworth (1900, p. 512) from New Britain and by May (1900 p. 86) from Zanzibar. The accounts of this species are by no means in agreement, and it is difficult to determine what are its distinguishing features. The name implies that there is a membranous expansion of the base, but this is only an adaption to the habit of growing on branches of corals. The pinnules of the tentacles are arranged in three or four rows according to Schenk, in four rows according to May, and in six rows according to Ashworth, but in all cases the lower end of the axis of the tentacles only is free from pinnules.

X. ternatana was originally described by Schenk (1897) from Ternate. A specimen from Zanzibar was referred to this species by Thomson and Henderson (1906, p. 412) on the ground that it has only two rows of pinnules. In many other respects it diverges from the type. The polyps are much larger than they are in the type and agree more closely with those of a typical *X. umbellata*, but if there are only two rows of pinnules they differ from this species to a very marked degree. It is often difficult to determine whether there are three or four or five rows of pinnules on the tentacles of the Xenias on account of contraction leading to overcrowding; but it should not be difficult to determine that there are two rows and not more than two rows. *X. ternatana* might stand, therefore, for the present as an independent species, but a more elaborate and detailed account of its tentacles is very desirable.

Xenia rigida (Th. and H., 1906, p. 413) must not be confounded with May's species of the same name. Kükenthal (1914, p. 8) has suggested that the name be changed to *Xenia crosslandi*. It was found in 10 fathoms of water. The species appears to be quite distinct as it has remarkably large (0·06 × 0·08 mm.) "rod-like" spicules. *X. coerulea* is almost certainly a young stage of *X. umbellata*.

Summary.—In the Zanzibar region there occurs one very variable species, *X. umbellata*, one doubtful species, *X. ternatana*, and in deeper water one species, *X. crosslandi*.

INDIAN OCEAN.—There is a well-defined species *X. garciae* (Bourne, 1895, p. 475) which is found in Diego Garcia and other reefs, *e. g.* Egmont reef, Addu Atoll and Hulule Male Atoll (Hickson, 1903, p. 479) in the Indian Ocean.

The polyps in this species are small, the body-wall being from 1·5–3 mm. in height, and the pinnules of the outer row of the tentacle almost meet on its aboral surface. The spicules are spherical or oval but smaller than usual—0·01–0·02 mm.—and very irregular in outline in the type-specimen.

X. nana from Ceylon is an even smaller species (Hickson, 1931), with only a single row of pinnules on each side of the tentacles. Some of the spicules are larger than usual, and it therefore seems to be quite distinct from *X. garciae.* But this species may be only a juvenile form of a larger one. A small form of *X. umbellata* has also been described from

Diego Garcia by Bourne, and specimens of *X. ternatana* and *X. umbellata* from Ceylon by Thomson and Henderson (1905, p. 273).

Malay Archipelago.*—Schenk (1896) described eight new species of *Xenia* from Ternate. Two were described from the examination of two specimens each and six from one specimen each.

There are many respects in which these eight species resemble one another. The length of the polyp body is 4–7 mm. except in *X. rubens*, where the figures given by Schenk are 6–11 mm. They have all with the exception of *X. ternatana* three pinnules in an oblique row on the tentacles, and they all bear spicules of the usual type of approximately the same size, *i. e.* about 0·02 mm. in diameter. The differences between them are mainly differences in the size and characters of the pinnules of the tentacles and in the form of the stalk, when present.

As these characters are very variable, it seems probable that all these species from Ternate are really forms of only one species, and that this species may be difficult to distinguish from *X. florida* of Dana. It may be premature to lump all these species into one at present, but the number should, in my opinion, be considerably reduced.

Xenia ternatana stands by itself in having only two rows of pinnules, a character which should be clearly recognizable even in preserved specimens from the three to four rows of pinnules in the other species. It would, however, be of great interest if it could be definitely known that in the specimens attributed to this species there are never more than two pinnules in a row in any of the tentacles.

X. plicata seems to be distinguished from the others by a greater degree of contractility of the pinnules and the remarkably long slender tentacles.

X. crassa, *X. fusca*, *X. membranacea*, *X. viridis* seem to me all variants of one species which should be called *X. crassa*.

X. blumi is closely related to *X. plicata*, with which it was found associated, and so is *X. rubens*, although according to Schenk's statement it has much shorter tentacles and on that account may be distinct.

The species from Ternate may therefore be reduced to three—*X. ternatana*, *X. plicata* and *X. crassa*—with two doubtful species, *X. blumi* and *X. rubens*.

Kükenthal (1911) attributed specimens found in 3–4 metres in the Kei Archipelago to the species *X. florida* and *X. viridis*. He does not give a full account of them, but according to his key plan (1902) *X. florida* should have two rows of pinnules and *X. viridis* three.

Dana (1848) described a species, *X. elongata*, from Amboyna with exceptionally large polyps (20–30 mm. in height). There is a piece of a colony in my collection from Celebes which resembles *X. elongata* in the exceptional size of the polyps and other respects. No mention is made by Dana nor by Wright and Studer of spicules in this species. In my specimen they are absent.

I am inclined to think, therefore, that *X. elongata*, Dana, should stand, for the present, as a distinct species.

Xenia hicksoni is the name given by Ashworth (1899, p. 245) for a single specimen from Celebes. It may prove to be only a local variety of *X. umbellata*, which it resembles in the general form of the colony, but it differs from that species in the smaller size of the polyps and in some other respects.

Pacific Ocean.—The coast of New Britain seems to yield a rich harvest of Xenias.

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* See Appendix, p. 177.

Ashworth (1900) described a new species, *X. novae-britanniae*, and referred other specimens to the species: *X. umbellata*, *X. membranacea*, *X. crassa* and *X. viridis*.

For reasons clearly stated by Ashworth (p. 521) *X. novae-britanniae* must stand as a distinct species. It was founded on the examination of eight specimens, all of which can be readily distinguished from the other species in the same region. The principal character is the relatively small size of the polyps.

The New Britain specimen of *X. umbellata* differs from the Red Sea type in some respects, but is correctly referred to that species. The other three should in my opinion be all referred to *Xenia crassa*.

A *Xenia* from New Ireland was described by Lesson under the name *Actinantha florida*. According to Kükenthal (1902, p. 647) this species is distinct from *X. danae* of the Fiji Islands, with which it was formerly confounded, in having only two rows of pinnules on each side of the tentacles. It is quite impossible to be certain of the characters of these two species described long ago by Lesson and Dana. Dana considered that his species from Fiji was identical with Lesson's species from New Ireland. Verrill (1869, p. 283), who had the advantage of examining all Dana's types, said he could see no difference between his specimen of *X. florida* and *X. umbellata*. Gray included Lesson's *Actinantha florida* in his genus *Loridella*, which has "fusiform spined spicules." Kükenthal (1902, p. 468) described a specimen from Port Denison under the name *X. florida* and states that it has only two rows of pinnules on each side of the tentacle, but gives no information as to the presence or absence of spicules.

It can lead to nothing but confusion if we try to retain these two species. We may take Verrill's opinion that *X. danae* is identical with *X. umbellata*, and relegate *X. florida* to the list of species that are imperfectly described.

Kükenthal (1914, p. 9) described a new species, *X. multispiculata*, from Fiji and Tonga. This species is clearly related to *X. crassa*, but differs from it in the greater size of the polyps (9–16 mm. in body length) and the larger number of pinnules in a longitudinal row (26–30). I have some specimens from Tonga collected by Mr. J. J. Lister which are more closely related to *X. crassa* as regards measurements, but in other respects resemble *X. multispiculata*.

I have also a most instructive series of ten specimens collected by Prof. J. Stanley Gardiner at Funafuti in the Ellice Group. There can be little doubt that they all belong to the same species, but, as they show various stages of contraction, they form a series which connects the more typical varieties of *X. crassa* with the description of *X. multispiculata*. In some specimens the pinnules are low warts, in others they are long and slender with a length of 0·75 mm., and in some cases both kinds of pinnules with intermediates are found in polyps of the same colony.

However, I have not found any tentacle with more than 16–18 pinnules in a longitudinal row, and the number in an oblique row is 3–4, not 2–3, as in *X. multispiculata*. There may be, therefore, a specific distinction between them.

In all the specimens from Tonga and Fiji I have examined the spicules are very numerous and crowded on the tentacles and pinnules, and most of them are discs with a diameter of about 0·02 mm. The spicules of *X. multispiculata* are said to be oval in shape with greatest diameter of 0·015 mm.

AUSTRALIA (including Torres Straits).—The Xeniid fauna of the Great Barrier Reef was described by Saville-Kent (1893, pp. 196–198), but unfortunately the four species that he named were never worked out in detail or clearly defined. He mentions a specimen of *X. elongata* with polyps half an inch (12·5 mm.) in diameter, and three other species which he could not identify—*X. pulsitans*, *X. ochracea* and *X. brunnea*. As his systematic work was so incomplete, some important and very interesting notes on the natural history of the species seem to have been generally overlooked by subsequent writers.

He laid great stress on the difference between the Xenias with fringed tentacles (*e. g. X. pulsitans* and *X. brunnea*) and those with tentacles that are minutely warted (*X. elongata*, and *X. ochracea*), and suggested that the latter should be placed in a distinct genus, *Paraxenia*.

He gave a detailed account of the colours of his four species, showing that there is a great diversity in the colour of specimens which he considered to be representatives of distinct species. A remark he made on the specimen found off Warrior Island, Torres Straits, which he called *X. pulsitans* is of special interest (*l. c.* p. 197). He said that it has expanded tentacles over an inch in diameter, and that "all the eight tentacles move synchronously, opening out and contracting in a continuous measured rhythm—like the pulsating contractions of a jelly-fish."

This extraordinary behaviour of a *Xenia* seems to be similar to that of a grey *Xenia* of the Red Sea, which Dr. Crossland informs me in a private letter, recently received, "rapidly opens and closes its tentacles."

The only other record of a species from this region is that of *Xenia florida* off Port Denison (Kükenthal, 1902, p. 648).

On the western side of Australia (Abrolhos Islands) there is a record by Miss Thorpe (Mrs. Hunter) of three varieties of *Xenia*—*X. blumi* var. *pelsarti*, *X. ternatana* var. *littoralis*, and *X. depressa* var. *kükenthali*. The principal difference between these varieties is in the characters of the pinnules; in other characters they are very much alike; and although we are grateful for a very full and careful account of the characters of the specimens, there may be still some doubt whether they are not varieties of only one species.

Antarctic Ocean.—*Xenia antarctica* was obtained by the Valdivia expedition at a depth of 457 metres east of Bouvet Island and described by Kükenthal (1906, p. 19). It has large polyps (10–12 mm. in length) and no spicules. It is distinguished from all the other species with large polyps in having only one longitudinal row of 14 pinnules on each side, and a number of very low wart like processes scattered irregularly on the oral surfaces of the tentacles.

X. depressa was described by Kükenthal (1914, p. 6) from a specimen in the Vienna Museum. It was said to be related to *X. bauiana* (May).

Arctic Ocean.—Jungersen (1892) described an Alcyonarian from 538 metres, N. 66°16′, W. 25°20′, under the name *Ceratocaulon wandeli*. According to Kükenthal (1906, p. 22) this is a *Xenia* closely allied to *X. antarctica*.

The list of species of *Xenia* as amended is as follows:

1. *Xenia umbellata*, Ehrb.

This species is widely distributed in the Red Sea, Indian Ocean, Malay Archipelago, Australian Barrier Reef and Pacific Ocean. It has large polyps and a low degree of contractility. Spicules absent or present. It includes the following as synonyms: *X. fuscescens*, Ehrb., *X. coerulea*, Ehrb., *X. bauiana*, May, *X. sansibariana*, May, *X.*

tumbutuana, May, and *X. quinqueserta*, May. *X. medusoides*, May, and *X. depressa*, Kükenthal, are probably varieties of this species.

2. *Xenia elongata*, Dana. Malay Archipelago.

This species has very large polyps. Spicules absent.

3. *Xenia hicksoni*, Ashworth. Celebes.

This species may be a variety of *X. umbellata* but it has smaller polyps.

4. *Xenia plicata*, Schenk. Malay Archipelago and Australian Barrier Reef.

This species has smaller polyps than *X. umbellata* with relatively long tentacles. Numerous spicules.

X. blumi and *X. rubens* of Schenk may be regarded as synonyms of this species.

5. *Xenia crassa*, Schenk. Malay Archipelago, Barrier Reef and Pacific Ocean.

This species has smaller polyps and relatively shorter tentacles than *X. plicata*.

X. fusca, *X. viridis* and *X. membranacea* of Schenk are probably synonyms of this species. For further considerations of the relations of *X. plicata* and *X. crassa* see p. 156.

6. *Xenia multispiculata*, Kükenthal. Fiji and Tonga. This species has larger polyps than *X. crassa*, but seems to be related to it.

7. *Xenia garciae*, Bourne. Indian Ocean. This species has small polyps (1·8–3·5 mm.), and the outer rows of pinnules almost meet on the aboral side of the tentacles.

8. *Xenia novae-britanniae*, Ashworth. New Britain. This species has larger polyps (2·8–3·5 mm.) and larger tentacles than *X. garciae*, and the outer rows of pinnules are widely separated on the aboral side of the tentacles. (See Ashworth, 1900, p. 520.)

9. *Xenia ternatana*, Schenk. Ternate, Zanzibar ? and Ceylon.

This species is said to differ from all the species mentioned above in having only two longitudinal rows of pinnules.

10. *Xenia nana*, Hickson. Ceylon.

This is a dwarf species with very small polyps and only a single row of pinnules on each side of the tentacles.

The following species were found in deep water and seem to be quite distinct (see pp. 151, 154).

11. *Xenia crosslandi* (*X. rigida* of Thomson and Henderson) off Zanzibar.

12. *Xenia antarctica*, Kükenthal. Antarctic Ocean.

13. *Xenia wandeli*, Jungersen. Arctic Ocean.

The following species have been so inadequately described that their correct identification is impossible : *Xenia florida* (Lesson), *X. danae* (Verrill), *X. samoensis* (Studer), and *X. ochracea*, *X. brunnea* and *X. pulsitans* (Saville Kent).

The study of the large collection of specimens of this genus from the Barrier Reef has made the task of arranging them in clearly defined specific groups extremely difficult. The characters that have hitherto been used for systematic purposes have proved to be so variable that they are almost useless, and any system based upon them must be provisional and artificial.

Taking a general view of the collection, there seems to be a rough grouping into three sets :

(1) Those with large polyps (8–10 mm. in body length) and relatively feeble powers of contraction, which I have referred to *X. umbellata* (Ehrb.)

(2) Those with smaller polyps (6–8 mm.) relatively long tentacles (4–6 mm., and greater powers of contraction, which I have referred to *X. plicata* (Schenk).

(3) Those with still smaller polyps (4–5 mm.) and relatively shorter tentacles (2–5 mm.) and still greater powers of contraction, which I have referred to *X. crassa* (Schenk).

There is naturally some overlapping between these groups, and there are some specimens that it is difficult to place definitely in any one of these species, but unless the extreme step is taken of lumping them all into one very variable species, this plan seems to me the only one that can be adopted.

The characters I have given of *X. plicata* and *X. crassa* do not agree entirely with the account of these species given by Schenk, but the illustrations he gives of them in his plates ii and iii do represent the differences between the groups in this collection which seem to prevail.

The specimens in the groups agree in having numerous discoid or oval spicules 0·02–0·025 mm. in size and in having 3–4 pinnules in an oblique row. In *X. umbellata* 4 pinnules in these rows is not uncommon, in *X. plicata* 4 pinnules occasionally occur, in *X. crassa* there are very rarely more than 3 pinnules. I have not seen any tentacle with two pinnules in a row or more than four.

The number of pinnules in each longitudinal row is very variable. In the larger polyps of *X. umbellata* there are 24–29, in *X. plicata* 18–22, in *X. crassa* 12–18.

Xenia umbellata, Ehrenberg.

There are two specimens collected at A 4′ south of the anchorage on Low Isles which I have referred to this species.

The striking features about them are the relatively larger size and comparatively feebler contraction of the polyps than in the others, and by their superficial resemblance to the specimens of *Heteroxenia elisabethae* from the Wishart's reef close by.

They are not dimorphic and neither of them shows at the margin any young polyps devoid of pinnate tentacles. In this respect, then, they are quite distinct from *Heteroxenia.*

The difference between them and some of the specimens I have referred to *X. plicata* is not so clearly defined, but they differ from them in having larger and stouter polyps, longer and wider tentacles, longer pinnules and fewer spicules in the body-wall. The two specimens were labelled α and γ respectively by the collector. Specimen α seems to be fully expanded; specimen γ shows some contraction of the tentacles, which, instead of being straight and outstretched, are bent over the oral disc. The latter therefore looks more like some of the specimens of *X. plicata* than the former.

Specimen α.—Springing from an irregular base (about 25 mm. in length), with a wide membranous expansion attached to an old coral branch, there is a low capitulum (ca. 60 × 25 mm.) with a stalk visible on one side only about 5 mm. in height.

The polyps are fully expanded, showing no contraction of the body-wall, and the pinnules even on the smallest polyps are slender and pointed cones. The larger polyps in the centre of the capitulum have a body-length of 10 mm. and the tentacles are 6 mm. in length. It is difficult to count the number of pinnules in an oblique row, but the usual number is three. There are four in some places, but never less than three. There are about 25 in each longitudinal row.

The spicules are very numerous in the tentacles, including the pinnules, but in the body-wall they are much more scattered than in *X. crassa*. They are mostly round in outline and ·02 mm. in diameter, but there are a few ovals slightly larger than this in one diameter. They have a pale orange colour.

Specimen γ.—This specimen has a very small base, 15 mm. in diameter, detached from its support. From the base rises a stalk which divides almost immediately into four branches. In the longest of these branches the distance of the capitulum from the base is 25 mm. The total width of the four capitula together is about 40 mm.

The difference in form of the two specimens is very striking, the one with a wide spreading base and a very short or no stalk and the other with a small base and long stalks. This difference is probably only due to the adaptation of growth of the colony to the support on which the larva happens to have settled. If a colony can spread at its base it does so and grows laterally, but if the support is small it has to grow in height and form a stalk or stalks.

The largest polyps are 10 mm. in height but the tentacles are shorter than in α, the longest I have measured being only 5 mm. in length. The pinnules are all long and pointed, and arranged as in α in oblique rows of three or four. The number in a longitudinal row is only 18.

The spicules are similar to those of α, very numerous in the tentacles, scattered in the body-wall. There seem to be rather more ovals than in specimen α, but the majority are round and a little smaller than in *X. crassa*.

These specimens were collected on April 24th, 1929. Gonads were not present.

Xenia plicata, Schenk. (Plate II, fig. 5.)

This species was described by Schenk from a single specimen growing on a madrepore branch at Ternate.

In the Great Barrier Reef Expedition collection there are five specimens from Low Isles and some others from Maer Island and Batt Reef, which resemble most closely the type of this species, but, as some of them show variations from the type, they afford interesting material for the determination of characters which are variable, and therefore of little value for systematic purposes, and characters which are less variable or invariable.

According to the short definition of the species given by Schenk (1897, p. 67) the colony is in the form of a thick stem with a slight concave upper end from which the polyps arise. The long tentacles bear three rows of short round wart-like pinnules on each side and the axis of the tentacles is free from pinnules throughout its whole length. There are 18–22 pinnules in each row. The numerous spicules scattered throughout the colony are discs which measure from 0·015–0·02 mm.* in diameter.

The form of the colony seems to be useless as a specific character, as in this collection there are specimens with a simple stalk as in the type, a divided stalk, a very short stalk and no visible stalk.

The length of the tentacles of the full-grown polyps, the number of rows of pinnules and the number of pinnules in each row are fairly constant characters. The spicules are variable in shape as between rounds and ovals. The pinnules of this and other species of *Xenia* are described by Ashworth and Schenk as "warts" to distinguish them from the long slender pinnules of *X. umbellata* and other species, and these authors divide the species into three groups: I, with long slender pinnules; II, with slender pinnules and warts; III, with warts only.

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* In the text the figures given are 0·015–0·2 mm. I think the latter must be a misprint for 0·02 mm. The largest spicules in any Xeniid hitherto described are only 0·1 mm. in diameter.

The difficulty I had in determining the position of these Xeniids was that, although in the majority of the tentacles the pinnules were all warts, in some a few pinnules were long and pointed. The question then was, Do they belong to division II or III of Schenk's system? In all other characters they are most closely related to *X. plicata*, which is placed by Schenk in division III.

There is no account of the appearance of these tentacles in the living specimens, but it is probable that in a healthy and fully expanded condition the pinnules are all or nearly all long and slender.

Description of the Specimens.

1. The Specimens from Low Isles.—Specimen A: The stalk arises from a base 20 mm. in diameter, and at a distance of 22 mm. from the base it divides into two branches. One branch has a maximum height from the base of 33 mm. and the other of about 30 mm. Both end convexly, and the expanded polyps of the two branches mingle to form what appears to be a single capitulum about 55 mm. in diameter.

The body of the larger polyps is 6 mm. in length and approximately 1 mm. in diameter when the polyps are fully expanded. The tentacles are very uniformly 6 mm. in length. The pinnules are arranged in oblique rows of three, and there are 18–20 pinnules in each row. The character of the pinnules varies a great deal. In most of the tentacles they are short round or dome-shaped warts. They vary so much in size in different tentacles and parts of the same tentacle that it is impossible to give a measurement of general application. In the middle of the tentacle a typical wart is about 0·15 mm. in height and 0·18 mm. in diameter. In some of the tentacles, however, there are pinnules which are slender and pointed at the extremity with a length of 0·4–0·6 mm. Between these and the ordinary warts every intermediate condition can be found. On the oral side of the tentacles there is a bare space between the pinnules which extends from the base almost to the extremity.

Specimen B: The base of this specimen is hour-glass-shaped, 32 mm. long by 10 mm. broad in the constricted part and 20 mm. broad in its widest part. From the base four very short stems arise, giving rise to a common capitulum 60 mm. in length. This specimen seems to be less contracted than the specimen A, the polyps are longer (5–7 mm. in height) and the pinnules are 4 in a row in the middle of the tentacles, 3 at the base and apex.

Specimen C is a long straggling colony 80 mm. in length with several bases of attachment. The greater part of it has no stalk, but at one end there is a stalk 12 mm. in height. The polyps resemble those of A more closely at one end and those of B at the other.

Specimens D and E are smaller than the others and have rather more contracted polyps.

Spicules are present in all these specimens and round or oval corpuscles approximately 0·02 × 0·025 mm. in size. They are found in large numbers throughout the superficial parts of the colony, including the tentacles and pinnules.

2. A specimen (Plate II, fig. 5) from Batt Reef, Patch 1, 7 miles E. of Low Isles, presents some difficulties. It is smaller than the others, and in some respects resembles *X. crassa*, suggesting that the separation of these species is artificial.

It differs from the specimens of *X. crassa* described in this paper in having relatively long tentacles and larger spicules, mostly ovals. From a membranous expansion at the base there rises an undivided stalk expanding above into a capitulum 50 mm. in diameter.

The body of the polyps is 4–5 mm. in height and the long slender tentacles 4 mm. in length. The pinnules are blunt pimples about 0·3 mm. in length, *i. e* they are intermediate between low warts and the slender pointed pinnules. There are 3 pinnules in the oblique rows and about 16 in the longitudinal rows.

3. The specimens from the N.W. reef flat of Maer island (11th May, 1929) are most difficult to describe and to identify, but afford an instructive study of variation in the genus.

On a dead coral branch about 120 mm. long there are several patches of *Xenia* polyps, united in many places by a thin membranous expansion of the base which spreads over the coral. Only in one place can anything of the nature of a stalk be seen, and the greatest height of this on one side is only 4 mm. This place shows, when cut through, a typical syndete 7 mm. in height. Elsewhere the polyps seem to arise directly from the membranous expansion. The continuity of these clusters proves almost conclusively that we are dealing here with one species, but it is impossible to say for certain whether the whole series is the product of one larva.

The size and structure of the polyps vary so much in different parts of the clusters that a single definite statement on either of these features, such as could be given in a table, cannot be made.

On the edges of the clusters and standing isolated on the stolon there are some very small polyps. These are not siphonozooids, as they show the full complement of 8 small tentacles bearing wart-like pinnules.

One of the largest polyps was removed for examination from the middle of one of the clusters. The length of the body is 8 mm. and its diameter 0·4 mm.; the tentacles are 4 mm. in length. The pinnules in these tentacles are principally warts, but there are some conical or pointed ones at the extremity with a length of 0·2 mm. The arrangement of the pinnules in rows is difficult to determine, owing to a transverse constriction of the tentacles, the rows, particularly at the distal end, becoming distorted and confused. At the basal end of the tentacles there are clearly 3 wart-like pinnules in each oblique row, but at the distal end there can be clearly seen 4 pinnules in some of the oblique rows. The exact number of pinnules in the longitudinal rows is also very difficult to determine, but there are at least 20, and perhaps a few more in the outer row. The bare track between the rows of pinnules on the oral side of the tentacles is clearly seen over the proximal half, but is greatly constricted distally.

Selecting the largest polyps from another cluster I obtained different results. The body of the polyps is 6 mm. in length and nearly 1 mm. in diameter, the tentacles were 5 mm. in length, and nearly all of the pinnules of the outer longitudinal row are long pointed cones and up to 0·3 mm. in length.

The spicules are abundant in the ectoderm of body, tentacles and pinnules. They vary in shape from round to oval. The size of the larger discs is 0·025 mm. in diameter and of the ovals 0·02 × 0·025 mm.

On further examination of several polyps and their tentacles I have come to the conclusion that no specific difference can be established between these specimens and those from Low Isles.

In the spirit specimens the Maer Island variety seems to have relatively shorter tentacles and rather more pinnules in each longitudinal row. The pinnules may be a little more contractile than in the Low Isles specimen, but no material differences can be seen in the size, shape or distribution of the spicules or in other characters of the polyps.

The spreading membranous expansion and almost complete absence of a stem are, in my opinion, characters of no specific importance, but dependent entirely upon age, the nature of the support and the conditions of the environment.

Xenia crassa, Schenk. (Plate II, fig. 4.)

A number of specimens collected by the expedition are most conveniently grouped together in the species *Xenia crassa* as amended above (p. 155). They may be described under the letters O, P, Q, R, S.

They were all found in shallow water off Low Isles. P and Q were found in the glades of the mangrove swamp, O and R on the Luana reef and S on the opposite side of the anchorage.

It is worthy of note that P and Q from the mangrove swamps have retained a pale blue colour. The others, which we may suppose were more exposed to the sun, are white or pale yellow.

As there is no information on the labels on the colour of these Alcyonaria when collected, I do not think this difference can be of any specific interest. All of these specimens were carefully examined, and a table constructed of their measurements and other characters.

They all had three oblique rows of pinnules, except that in some tentacles of Q there was a fourth in the row in the middle of the tentacle. The number of pinnules in each longitudinal row, which was very difficult to count in some cases, varied from about 12 to 18 but did not exceed 18.

In all the specimens there were numerous spicules in the body-wall, axis of the tentacles and in the pinnules. They were round or oval in shape, and varied from 0·015 to 0·02 mm. in size.

In other characters there were wide variations, so wide indeed that under the old system several distinct species would be proposed for them. The specimen Q from the mangrove swamp afforded a most instructive example of what the range of variation in a species may be in preserved specimens.

This specimen is attached to a branch of dead coral. It consists of two capitula connected together by a thin band 12 mm. extending from the membranous expansion of the base. The capitula are 30 mm. and 23 mm. respectively in diameter. There is no stalk at the base of either capitulum, but the syndete in the larger one is about 4 mm. thick in the middle.

There can be no doubt whatever that the two capitula are parts of the same colony, and yet the polyps differ from one another to a remarkable extent, as shown in the following table:

	Diameter.	Body length of polyps.	Length of tentacles.	Pinnules.
Capitulum I	30 mm.	8 mm.	5·5 mm.	0·45 mm., long and pointed
Capitulum II	23 ,,	2·5 ,,	2 ,,	Very low warts.

These are measurements of a typical polyp taken from the centre of each capitulum, but a critical examination of the larger capitulum shows that there are several smaller polyps near the margin with low wart-like pinnules as in the smaller capitulum.

This specimen also throws light on some other characters which have been used for the determination of species. Schenk and May give as a distinguishing feature of *X. rubens* that there are five or six irregular rows of little warts scattered over the inner side of the tentacles, and May characterizes *X. bauiana* and *X. medusoides* by having pinnules on both sides of the tentacles. Both these conditions are found in some of the polyps of this specimen. In the fully expanded tentacle the outer longitudinal row of long pointed pinnules is always on the edge of the tentacles, the aboral surface being quite free. In the polyps that are more contracted the wart-like pinnules appear to be scattered irregularly on the oral side of the tentacles; and in some of the most contracted tentacles pinnules seem to be irregularly arranged all round the axis, as they are said to be in May's *X. medusoides*. It is true that in *X. bauiana* and *X. medusoides* the pinnules are said to be long and slender, whereas in these forms they are usually wart-like in shape; but the great variety in the forms of pinnules in specimen Q leads me to the conclusion that the appearance of pinnules on the aboral side of the tentacles is always caused by contraction. The specimens I have attributed to this species from the Barrier Reef were as follows:

Specimen O: This specimen has a capitulum 42 × 38 mm. There is a short stalk not exceeding 10 mm. in height springing from an almost circular compact base (25 mm. in diam.). The polyps are densely crowded and somewhat contracted. The body length is about 5 mm., the tentacles 4 mm. in length, the pinnules of some of the polyps long (0·3 mm.) and pointed. The spicules have a pale orange colour. The colour of the specimen in spirit is dull white.

Specimen P: This is the most completely contracted specimen of a *Xenia* I have seen, and I refer it to this species with some hesitation. It has a capitulum 21 × 25 mm. on the end of a thick stalk 8 mm. in height springing from a wide membranous base, spreading over the surface of a branch of *Porites* to which the colony is attached.

The body-wall of the polyp is folded and contracted down to a height of not more than 1 mm.; the tentacles are 1·25 mm. in length; the pinnules are very short and blunt.

The spicules have an orange-brown colour like those of specimen O.

The colour of the colony in spirit is pale blue.

Notwithstanding the very striking differences between this specimen and others, I am inclined to the view that its peculiarities are all due to contraction. It has, like the others, three rows of pinnules on each side of the tentacles, and there are from 15–18 in each longitudinal row. There is nothing in the shape, size or distribution of the spicules to distinguish this specimen from the others.

Specimen Q has been described above. It was found in the same mangrove swamp as Specimen P.

Specimen R (Plate II, fig. 4): This specimen, found in close proximity to specimen O, closely resembles it in every respect, except that it seems to be rather more contracted. In my original notes, made without reference to other specimens, I put down the statement that "the pinnules are low warts." On comparing it again with specimen O I find no reason to alter this statement, as I can find no polyps with pinnules as long or as pointed as they are in some of those in specimen O.

If we were to adopt the key plan of Kükenthal (1902) and other authors these two specimens would be placed in widely separated species.

Specimens: In this specimen there are four main stalks springing from an irregular base of attachment about 14 mm. in diameter. The highest stalk is 10 mm. in height, but seems to break up into a few secondary branches. The combined heads of these branches form a capitulum about 35 × 20 mm. in extent.

This specimen differs from the others not only in the more profuse branching of the stalk, but in characters which may be due to a different effect of contraction. The body-wall of the polyps is very short, the longest being 2–3 mm. and in many of them only 1 mm. The tentacles are also very short, none of them exceeding 2 mm. in length, but the pinnules seem to be all fully expanded, being the longest I have observed in the group, and in some cases 0·6 mm. in length and sharply pointed at the extremity.

The Genus CESPITULARIA, *Milne-Edwards.*

This genus was revised by Kükenthal (1902, p. 657). The principal characters are that the colony is dendritically branched and that the margin of the capitulum is not sharply defined, the polyps (*i. e.* the anthocodiae) arising not only from the summit of the branches, but in gradually diminishing numbers down their sides (see Plate I, fig. 2; Plate II, fig. 6).

Five species have hitherto been described:

Cespitularia mollis described by Brundin (1896, p. 4) from 120 metres of water in the Korea Straits; *C. multipinnata** and *C. subviridis** by Quoy and Gaimard from the Pacific Ocean, and *C. taeniata* and *C. coerulea* by May from Mozambique and Zanzibar respectively.

Three specimens of *C. coerulea* were also described by Thomson and Henderson (1906, p. 415) from Zanzibar. To these species it is now proposed to add two new ones, *C. wisharti* and *C. mantoni*, from the Great Barrier Reef.

C. mollis must be regarded as a distinct species not only on account of its exceptional geographical and bathymetrical position, but on account of the presence of spicules which are twins, quadruplets and hour-glass shaped (up to 0·05 mm. in size), sparsely distributed in the coenenchym and other characters.

All the other species are found in shallow tropical waters, and none of them have spicules with the same characters as those of *C. mollis*.

Spicules have not hitherto been described in any other species, but in the case of *C. multipinnata* and *C. subviridis* some very unsatisfactory figures of spicules are shown in the plate illustrating the type-specimens. It seems probable, therefore, that the type of *C. multipinnata* had spicules, although very improbable that they were spindle-shaped, as shown in the drawing. The type of *C. subviridis* was probably a *Xenia* (see p. 163).

C. mantoni is a new species distinguished by its very large spicules (Text-fig. 5, p. 168).

C. wisharti is a new species which resembles *C. multipinnata* in having numerous wart-like pinnules between the lateral rows, but has no spicules.

The Zanzibar species (*C. coerulea*) and the Mozambique species (*C. taeniata*) have no spicules, and there are no pinnules on the tentacles between the lateral rows. They differ from one another in minor characters, but may prove to be identical.

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* These two species were described under the generic name *Cornularia*.

The species described and figured by Quoy and Gaimard as *Cornularia subviridis*, and subsequently referred to the genus *Cespitularia* by May, is not in my opinion a member of this genus at all. Neither the description nor the figures (Plate XXII, figs. 1–4) of the type suggest that it is branched or dendritic in form, and as it was said to be a foot in expanse it was certainly not a juvenile stage of a branched adult.

It has the appearance of an ordinary *Xenia*—probably *X. umbellata*—and the only point in which it has a remote resemblance to a *Cespitularia* is that one or two polyps are shown a little below the margin of the capitulum, but even in this respect it is unlike a typical *Cespitularia*, because in this genus the polyps below the summit of the branches are more numerous, extend further down the branch, and are smaller in size than those above them.

A specimen supposed to be a variety of *C. subviridis* described and figured by Quoy and Gaimard may be dimorphic and a *Heteroxenia*. It is certainly not a *Cespitularia*.

Notes on the Genus Cespitularia.—The generic name *Cespitularia* was founded by Valenciennes (in MS.) for the type-specimen of *Cornularia multipinnata* Q. & G. This specimen has never been satisfactorily described, but the generic name was accepted by May (1900, p. 89), and two new species supposed to belong to the same genus were added.

Kükenthal's definition of the genus given above is satisfactory for *C. mollis*, *C. taeniata* and *C. coerulea*, but is very unsatisfactory as a description of the type of *C. multipinnata* as it is figured by Quoy and Gaimard.

I have accepted the generic name with some hesitation on that account, but only on the assumption that some errors have crept into the description of the type species.

The species of the genus I have examined are distinguished from *Xenia* by the character that the polyps are more contractile, and that very often they are so far retracted as to be indicated only by low verrucae. From the descriptions of the other species this may be an additional diagnostic character.

None of the species are dimorphic, and in all the specimens examined the ventral and lateral mesenteric filaments are absent.

Cespitularia multipinnata, Q. & G.

Some confusion has arisen on account of the transposition of the description of the figures of *Cornularia multipinnata* and *C. subviridis* by Quoy and Gaimard. At the end of vol. iii there is a list of errata stating that the figures on pl. xxii, figs. 1–4, illustrate *Cornularia subviridis*, and on pl. xxii, figs. 5–7, illustrate *C. multipinnata*, and not as printed in the description of the plate.

The species has not been obtained since the voyage of the "Astrolabe," but has been referred to the genus *Cespitularia* by May (1900) and by Kükenthal (1902, p. 659) on the strength of the original description and figures by Quoy and Gaimard. If it is correct to refer the specimens obtained by the Barrier Expedition to this species, it must be assumed that the figures of the type are not quite accurate in several respects.

In the first place the spicules are drawn in the form of spiny spindles about 3 mm. in length. No statement is made as to the enlargement of any of the figures, so that we are left in the dark as to the actual size of these spicules, but neither the Barrier Reef specimens of this species nor any other known species of the family Xeniidae have spindle-shaped spicules. All that it seems safe to assume is that the type had small spicules.

Kükenthal (1902, p. 660) says that there are "zahlreiche Pinnulae in 3–4 unregelmässigen Reihen auf der Innenseite der cylindrischen Tentakel."

In the original figures there are only a few scattered pinnules on the inner side of the tentacles between the two outer rows. There is no indication of rows of pinnules, regular or irregular, between the two lateral rows. I have not seen anything in any Xeniid corresponding with the original figure of the tentacle of the type.

The two specimens which I have referred to this species were collected on Three Isles about 75 miles north of Low Isle. They were labelled "Xeniid-like forms" ω and ω^2 respectively.

The character of the branching of both these colonies is better expressed by the term shrubby than dendritic (baumförmig), but in both of them the ramification is much more profuse than in any specimen of a true *Xenia* that I have seen.

Moreover the branches are not terminated by a capitulum with a well-defined margin, but the polyps (*i. e.* anthocodiae) are scattered irregularly and of various sizes over the upper part of the stalk in the longer branches or the whole of the stalk in the shorter branches (Plate II, fig. 6). There is so much variety in the size of the polyps that it is difficult to give measurements that have any exact meaning. If one of the largest polyps on one of the branches be taken, the body-wall is 2 or 3 mm. in height and 1·5 mm. in diameter, but other polyps on the same branch and of the same diameter have a height of less than 0·5 mm. On every branch there are smaller polyps with small but fully developed tentacles with no appreciable body-wall at all, the crown of tentacles being flush with the surface of the branch.

The largest tentacles are about 4 mm. in length, but the tentacles show many degrees of contraction. In a tentacle which seems to be fully expanded there is on each side an outer row of about 15 pointed pinnules, reaching a maximum size of 0·5 mm. On the oral surface of the tentacle there are numerous pinnules varying in shape from short pointed pinnules to low warts. These pinnules do not usually seem to have an orderly arrangement, but in some places there is roughly a series of four in an oblique row on each side. There may be also at the base a short space between the rows free from pinnules.

In most of the tentacles the pinnules are low warts scattered quite irregularly over the oral surface of the tentacle.

In both specimens there are numerous spicules in the body-wall and tentacles and in the stalk. They are mostly oval in shape and have a length of 0·03 mm. and a breadth of 0·025 mm. They are a trifle larger than the spicules in most of the species of *Xenia*. No mention is made in the literature of the presence of spicules in this species, but small spiny spindle-shaped spicules are figured by Quoy and Gaimard in the plate illustrating the type-specimen.

The two specimens are very much alike in general appearance, but in specimen ω the polyps are rather more contracted than in specimen ω^2.

In ω there is a very irregular base from which rises a very short stalk, breaking up almost immediately into numerous branches which again branch irregularly. The height of the colony is about 50 mm.

A careful examination of the polyps, the tentacles, the pinnules and the spicules does not show any material difference from the characters of these structures in specimen ω^2.

Cespitularia multipinnata ? juv.

A small specimen was found by Dr. Manton on Escape Reef in July, 1929, which may be a young stage of *C. multipinnata*. Escape Reef is on the outermost margin of the reef platform.

The specimen has a base of attachment 20 by 10 mm., and its greatest height is about 15 mm. It has a very short stalk, which divides into a number of short, lobate branches. As in other specimens of *Cespitularia* there is no clearly-defined margin to the capitula, small scattered polyps arising right down to the base. The polyps are very much smaller than they are in the specimens described above, and many of them are very slightly contracted. In the most fully expanded polyps the body-length is 1·25 mm. and the diameter 0·75 mm. The tentacles are 0·75 mm. in length.

There is a single row of 9 pinnules on each side of the tentacles and of these 4 are short and wart-like, and the distal 5 are long and digitiform with a maximum length of 0·2 mm.

There are numerous disc-shaped spicules in the polyps and in the stalk with a diameter of 0·025–0·03 mm.

The colour of this specimen, when alive, was blue. No gonads were observed.

The difference in the character of the tentacles of this specimen and of the type might appear to justify the proposal of a new species. It is not strictly speaking multipinnate. The general resemblances in other respects suggest that the median wart-like pinnules of the type may not appear until a later stage in growth. A point of some interest in this connection is that the spicules are all disc-shaped, and just that little bit larger than the spicules of most of the species of *Xenia*, which was noted in the larger specimens from Three Isles.

Cespitularia wisharti, n. sp. (Plate I, fig. 3.)

Two specimens belonging to this genus were found on Wishart's Reef in Low Isle (23.v.29). In general form and mode of growth they are similar to the specimens of *C. multipinnata* described above, but differ from them in several characters.

The colour in spirit is pale yellow, in striking contrast to the greenish-grey colour of the other species. The polyps are decidedly more fully expanded but smaller. The substance of the colony is soft and flabby, and there are no spicules either in the polyps or in the stalk.

The absence of spicules in the Xeniidae has usually been regarded as a negligible character in the determination of species, as it may be due to prolonged immersion in a preservative which is acid in reaction.

When I found that the spirit in which these specimens were preserved gave a slightly acid reaction, whereas the spirit in which the specimens of *C. multipinnata* were preserved was neutral, it seemed possible that this accounted for the absence of spicules in *C. wisharti*. It did not seem probable, however, that this slight acidity could account for the total absence of the spicules throughout the colonies.

To test the matter further some polyps and coenenchym of *C. multipinnata* were treated with weak HCl for some days and subsequently stained and mounted in balsam. These preparations were compared with preparations of *C. wisharti* similarly stained and mounted. The difference between them was striking. In the former spaces in the epithelium were observed, which corresponded with the shape and size of dissolved spicules, and the epithelium was also ruptured in places where the gas had escaped. No such spaces were seen in the epithelium of the latter.

The conclusion therefore is that in this case at least, the absence of spicules is a good specific character.

The specimens are about 90 × 40 mm. and 80 × 20 mm. respectively in expanse and they are both about 40 mm. in height. Neither of them has a simple base of attachment. One of them has five quite distinct bases and the other two, all irregularly circular in shape, and from 10–15 mm. in diameter. The lower branches from these bases completely fuse, so that above the bases there is one indivisible colony. There seems to be no reason to suppose that this is due to the fusion of colonies which, in a younger stage, were distinct; but, as the supporting coral, or whatever it was, is missing, the manner in which the original colony spread cannot be determined.

The combined stalk from these bases gives rise to numerous columns dividing into lobate processes about 10 mm. in diameter and 40 mm. in height.

There are numerous polyps on the ends of these processes, fewer at the sides, and there are a few small stray polyps right to the base of the processes (Plate I, fig. 2).

The largest polyps are 1·5–2 mm. in height and about 0·6 mm. in diameter, and the tentacles are 1·6–2 mm. in length.

The difference in size, as expressed in figures, of these polyps and of those of *C. multipinnata* does not seem very considerable, but these specimens are clearly more fully expanded than the others, and probably the difference between them is still more pronounced in the living fully expanded condition.

On the oral side of the tentacles there are numerous pinnules, varying from long pointed forms 0·5 mm. in length to low warts. At the base of the tentacles the pinnules are sometimes arranged in two rows on each side with a space between them; in the middle there is no definite arrangement, but there are 4–5 pinnules across the width of the tentacle, and at the apex there are 4 or 5 pinnules in a single longitudinal row on each side with a broad space between them.

This seems to be the most usual arrangement of the pinnules, but there are some variations of it which may be due to contraction.

Cespitularia wisharti ? (Plate II, fig. 7.)

A specimen from an unknown locality collected by the Expedition is marked "π ? ?," signifying, I suppose, that it might be the same species as the specimen of *C. wisharti* which was marked "π." It is adherent to a branch of dead coral, and consists of two parts connected together by a cylindrical band 5 mm. in diameter, only partially attached below to the coral, the whole being 45 mm. in length. The larger part is about 20 mm. wide by 15 mm. in height, and appears to be a typical *Cespitularia* colony with short lobes; the smaller part bears two short lobes about 8 mm. in height. Many of the polyps are greatly contracted, and some of them retracted into verrucae. The largest polyps, which are undoubtedly considerably contracted, have a body-length of 1 mm. and tentacles 0·5 mm. The tentacles are so much contracted that it is difficult to determine the exact arrangement of the pinnules. They are, however, certainly multipinnate, and in one polyp that was exceptionally well expanded the arrangement was as follows: at the apex of the tentacle there were three pinnules in a single longitudinal row, with a space between them; in the middle of the tentacle there were in addition to the lateral pinnules a few low mound-like pinnules scattered about between them; at the base the median scattered pinnules were absent. The longest pinnules measured were only 0·07 mm. in length. There were no spicules in any part of the colony.

Another small specimen marked "π ?" and with a label marked "A 14 ? 11.iv.29" may provisionally be referred to this species. If the reference, A 14 = A 5 of the map, is correct, the specimen was found in the neighbourhood of the anchorage on Low Isle, and therefore not far from Wishart's Rock.

The specimen is remarkable in having the polyps more fully expanded than they are in any specimen of the genus I have seen.

It is 30 mm. in length, and divided by a short band into two parts as in the specimen described above. The larger end is 12 mm. wide and has four short lobes with the characteristic features.

The largest polyps have a body-length of 1 mm. but the slender tentacles are 2 mm. in length, and many of the delicate filamentous pinnules reach the extraordinary length of 0·6 mm.

The contrast between the tentacles of this specimen and of the other small specimen mentioned above is very striking. With a body-length of the polyp of approximately the same size, the tentacles of the former are 0·5 mm., of the latter 2 mm. in length, and the pinnules of the former 0·07 mm., and of the latter 0·6 in length.

There can be no doubt that the two specimens belong to the same species, and that this difference is only an instructive example of the contractility of the tentacles.

Cespitularia mantoni, n. sp. (Plate I, fig. 3.)

The single specimen for which I propose a new specific name was found by Dr. Manton in July, 1929, on Ruby Reef, a reef situated on the outermost margin of the Barrier platform.

It has a general resemblance, in spirit, to the small specimen of *C. multipinnata* found on the neighbouring Escape Reef, and like that specimen it was blue in colour when alive.

Miss Manton's note, however, " not the same species as that on Escape Reef," called for a detailed examination of the two specimens, and this led to the discovery of the very large spicules of this species and a confirmation of Miss Manton's field observation.

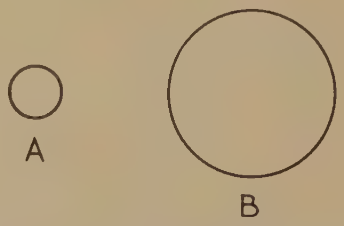
The specimen has an oval base of attachment 30 × 20 mm. There is a well-marked stalk about 10 mm. in height giving rise to about eighteen lobes of a typical *Cespitularia* character. They are about 10 mm. high by 8 mm. in diameter, irregular and discrete, and form a capitulum about 40 mm. in diameter. Many of the polyps are considerably contracted. The largest have a body-length 1·75 mm., and the most fully extended tentacles are less than one 1 mm. in length.

These small tentacles have a row of 4 or 5 pinnules on each side, with a broad space between them on which I can see no evidence of wart-like pinnules.

The most remarkable feature of the species is the enormous size of the spicules. Whereas in most species of the Xeniidae which have spicules the maximum size is 0·02–0·025 mm., in this species they are 0·1–0·12 mm. in diameter. They are therefore four to five times greater in diameter than the spicules of any other species, and are quite visible to the naked eye in a section of the coenenchym (Text-fig. 5).

They are not very numerous nor of the maximum size in the tentacles and body-wall of the polyps, but in the coenenchym rows of these large brown spicules can be seen running parallel with the coelentera of the polyps. They are dark brown in colour and when isolated seem to be always round in outline, but, in some places, the round discs are fused together into irregular lumps.

The specimen was male with gonads 0·15 mm. in diameter.



Text-fig. 5.—These circles are drawn to scale to show the relative sizes of the spicules of A, *Cespitularia multipinnata* from Escape Reef, and of B, *Cespitularia mantoni* from Ruby Reef. Both these reefs are on the Outer Barrier.

The Genus HETEROXENIA, *Kölliker.*

The only definition of this genus that is necessary at present is: Xeniidae with dimorphic polyps. Possibly at some future time the S. African species may find a place under a new generic name; but it seems a better plan to keep them all together until our knowledge is extended.

The type of this genus is *Heteroxenia elisabethae*, Kölliker (1875), which was found at Port Denison, Queensland; other specimens attributed to the same species were obtained by Haddon from Torres Straits and by the Great Barrier Expedition from the Low Isles.

Ashworth (1899), Bourne (1895) and Thomson and Henderson (1906) have given the same name to specimens from Zanzibar, and Light (1915) records the species from the Philippine Islands.

Kükenthal (1902, p. 653) considered that the specimens described by Ashworth and by Bourne were distinct from Kölliker's type-species, and referred them to a new species, *X. ashworthi*, on the character of 3 pinnules in a row on the tentacles, instead of 4, as in the type. Thomson and Henderson in their description of specimens from Zanzibar state that the number of pinnules in a row is 4, but occasionally there are 5. Ashworth also distinctly states that although 3 pinnules in a row is the usual number, there may be 4 in a row at the base of the tentacles. May (1900, p. 85), who examined specimens from Zanzibar collected by Sander and Stuhlmann, said there are four rows of pinnules. If it could be shown that the specimens of this genus from the Red Sea and Zanzibar had invariably 3 pinnules in a row, and those from the Australian waters invariably 4, there would be some reason for considering the former to be specifically distinct from the latter, but as specimens from both localities have been described with three and four rows, this specific distinction cannot be maintained, and *Xenia* vel *Heteroxenia ashworthi* must lapse.

Kükenthal considered Kölliker's *Heteroxenia elisabethae* to be synonymous with Ehrenberg's *Xenia fuscescens*—a conclusion with which I cannot agree (see p. 173).

Other species which must be referred to the genus *Heteroxenia* are *H. capensis*, Hickson, from the Cape of Good Hope, *H. rigida*, May, from Mozambique, and *H. uniserta*, Kükenthal, from Simon's Bay.

Heteroxenia elisabethae differs from the other dimorphic species by the very obvious character that the siphonozooids in preserved specimens project 2–9 mm. from the surface of the stalk. The autozooids also appear to be less contractile than they are in the other species.

As *H. capensis* and the other two species, if they are distinct, exhibit a dimorphism similar in general characters to that of other dimorphic Alcyonaria, the whole controversy on the value of dimorphism as a character for generic importance depends upon the facts and interpretation of the characters of *H. elisabethae.* I have therefore made a careful study of the structure of the well-preserved specimen of this species collected by the Expedition, and compared it with that of all the other specimens I have been able to obtain.

In the collection made by the Barrier Reef Expedition there is one specimen of *Heteroxenia elisabethae* which I have described in detail on p. 173.

I have also examined three specimens of the same species collected by Prof. Haddon in Torres Straits, and six specimens collected by Dr. Crossland off Zanzibar.

The smallest specimen (from Zanzibar) is only 15 mm. in height, and the spread of the capitulum is only 12 mm., but the dimorphism of the polyps is as clearly seen as in the larger specimens.

With these specimens I have compared the descriptions and measurements of specimens described by Kölliker (1874), Ashworth (1899), May (1900), Kükenthal (1904), Thomson and Henderson (1906), and Cylkowski (1911), and I have constructed a table of the characters usually employed in the determination of the species of Xeniidae from the results thus obtained. My first object was to determine whether the Xeniids which have been described under this name represent only one species, two species or more than two species.

If there is only one species its geographical distribution is remarkable. It occurs in the Red Sea and off Zanzibar, but has not been found hitherto off Ceylon or in the archipelagos of the central part of the Indian Ocean.

It is found in the Philippine Archipelago (*fide* Light, 1915), and on the reefs of the East coast of Australia and Torres Straits. It may occur in the Malay Archipelago,* but no specimens have yet been recorded from that region, nor from Singapore. It does not occur so far as we know in any of the archipelagos of the Pacific Ocean.

If there is, as the evidence seems to prove, a very wide sea area between the localities in the east and in the west where it does not occur, it might be expected that some specific distinction between the specimens of the two regions would be found. All that can be said is that, at present, no such specific distinction has been found, and the species *Heteroxenia elisabethae* should be considered to be indivisible.

This statement is based on the consideration of the characters in my table referred to above and the following may be regarded as a summary of this table.

Size.—The largest specimen from the Australian region that has been described is the type from Port Denison. According to Kölliker's figure it was about 180 mm. in diameter across the capitulum and the stalk was 80 mm. in height. The smallest specimen from this region in my collection is only 15 mm. across the capitulum, and has a stalk 8 mm. in height.

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* See Appendix, p. 177.

There are not many data as to the actual size of the larger specimens from the Red Sea and Zanzibar areas. One specimen measured by Thomson and Henderson (1906, p. 413) had a capitulum with a diameter of 35 mm. and a stalk 25 mm. in height. There are reasons for believing that some of the specimens from the Red Sea were much larger than this one. The smallest specimen in the Crossland Collection has a capitulum 15 mm. in diameter and a stalk 10 mm. in height. There is no doubt that Kölliker's specimen from Port Denison is the largest that has been described. Apart from this there does not seem any reason to suppose that the specimens from the Australian region are larger on an average than those from the Red Sea region.

Size of the autozooids.—There is also a wide range of variation as regards the size of the autozooids. From the Australian region the autozooids of Kölliker's specimen were 20–40 mm. in height, of the specimen described in this paper 10 to 15 mm., and of some specimens in Haddon's collection only 5–7 mm.

From the Red Sea and Zanzibar region the autozooids of Ashworth's specimen were 10–25 mm. in height, of Thomson and Henderson's 15–22 mm., of Kükenthal's 20–40 mm., of Cylkowski's 3–50 mm.

There is clearly some correlation between the size of colony and the size of the autozooids: the larger the colony, the larger the autozooids.

If we take the expanse of the capitulum as the standard of the size of the colony and compare it with the size of the body of the largest autozooids, we get the following results:

	Diameter of capitulum.	Length of largest autozooids.
Kölliker's specimen	130	40
G.B.R.E. ,,	55	15
Haddon's ,,	25	5
Ashworth's ,,	about 30	25
Th. and H.'s ,,	35	22
Crossland's ,,	15	2

The figures given in these columns represent only the measurements of preserved specimens; no account is taken of the degree of contraction of autozooids, which, in some cases, is considerable. The autozooids of Haddon's specimens were obviously much more contracted than any of the others. If the measurements had been taken of the specimens alive in their natural position on the reef the figures would have been different, but I think there can be no doubt that a similar correlation between size of colony and size of autozooid would have been found.

The pinnules.—The tentacles of the autozooids in all the specimens of the species have numerous pinnules on both sides of the rachis. They are arranged roughly in oblique rows of three or four, and in longitudinal rows of 16–25 or more. In some cases the oblique rows are quite clear, but in others, particularly in those that are slightly contracted, the pinnules seem to be more unevenly distributed and the arrangement in rows is indistinct. It is always very difficult to determine with accuracy the exact number of pinnules in every oblique row of a single tentacle, and still more difficult and time-absorbing to determine whether there are any variations in the number of pinnules in the oblique rows in the autozooids of a single colony.

Some authors in their descriptions of the species of the Xeniidae give a simple statement that the number of pinnules is 3 or 4 as the case may be.

Ashworth (1899), however, in his description of *H. elisabethae* from Zanzibar, says that the usual number of pinnules in a row is 3, but there may be 4 at the base of the tentacles. Thomson and Henderson (1906) in a description of specimens from the same locality say there are 4, but there may be 5. Cylkowski (1911) says there are 4, seldom 5 or 3 in specimens from Jidda.

When I first examined the specimen collected by the Great Barrier Reef Expedition I put down in my notes that there are 3 pinnules in an oblique row, but the number given by Kölliker for the type is 4. I endeavoured to find out some facts as to the variation in the number of pinnules by a careful examination of several tentacles. I took three autozooids from the middle of the capitulum and three from the periphery, dissected off the tentacles, and examined all of them by reflected and by transmitted light. The notes I made are as follows:

> *Median autozooids.*—1. At the base and at the extremity of the tentacles there are 2 in a row, in the middle there are 3.
>
> 2. All the tentacles have 4 pinnules in a row except at the base, where there are 3.
>
> 3. All the tentacles have 4 in a row in the middle, 3 at the base.
>
> *Peripheral autozooids.*—1. Distinctly 4 in a row in the middle.
>
> 2. At the base 3 or 4, in the middle 4, but in one tentacle there were not more than 3.
>
> 3. Some tentacles with 4 in a row, some with only 3.

From this evidence it is clear that the variation in the number of pinnules in a row is such that the separation of *H. ashworthi* from *H. elisabethae* proposed by Kükenthal is unsound.

Spicules.—According to Kölliker there were numerous spicules, 0·019–0·024 mm. × 0·01–0·015 mm. in size in the type-specimen. May, however, says that he could find spicules in only one of the specimens he examined. In the Great Barrier Reef Expedition specimen and in all the specimens in the Haddon collection I have examined there are numerous spicules approximately 0·025 × 0·02 mm. in size.

Bourne gives the size of the spicules of the specimen from Zanzibar as 0·02 × 0·01 mm. Thomson and Henderson say that in their specimens, also from Zanzibar, there are numerous spicules 0·001 mm. in diameter. (I think there must be a mistake or a misprint in this figure, as in the specimens of this collection which I have examined the spicules are at least 0·02 mm. in diameter.)

In the specimens called *X. fuscescens* by Kükenthal (1902, p. 654) the spicules are said to be present or absent, and in the specimens from Jidda, Cylkowski (1911, p. 4) says the spicules are absent.

Klunzinger (1877, p. 41) says the spicules of *X. fuscescens* are similar to those of *X. umbellata*, in which they are " 0·008 bis. 0·016–0·024 mm." in size.

According to my own observations the spicules of *H. elisabethae* are thin discs, oval or more irregular in shape with a maximum diameter of 0·025 mm.

The reported absence of spicules in some specimens is noteworthy. The spicules, however, are often so thin and transparent that they may be easily overlooked, and if the preservative is acid in reaction they might be destroyed or rendered very inconspicuous. In any case the character of "absence of spicules" without confirmation cannot in this case be accepted as a sole ground for specific distinction.

Heteroxenia elisabethae, Kölliker.

MEASUREMENTS IN MILLIMETRES.

Locality of specimens and authority.	Height of autozooids.	Height of siphonozooids.	Length of tentacles.	Greatest diameter of spicules.	Number of pinnules in an oblique row.	Number of pinnules in a long row.
Port Denison, Kölliker	20–40	7–8	15	0·019–0·024	4	. .
Torres Straits, Hickson	5–7	2–2·5	4–7	0·02–0·025	1, 2 or 3	18–20
Low Isles, Hickson	15	9	6	0·02–0·025	3 or 4	20
Zanzibar, Ashworth	10–25	2–5	4–5	0·02	3 or 4	16–24
,, Th. & H.	15–22	4–5	5·5–6·5	0·001 (?)	4	?
Sinai, Kükenthal	20–40	3–5	15	Present or absent	4	?
Jidda, Cylkowski	3–50	?	3–12	Absent	Rarely 3 or 5	. .

Summary.—There is not any sound specific distinction between the *Heteroxenia elisabethae* of the Australian Barrier Reef and the *H. elisabethae* of the Red Sea and Zanzibar.

Three other species of the Xeniidae are undoubtedly dimorphic, and it may be observed that they all came from off the coast of S. Africa, and agree with each other in having a single row of pinnules on each side of the tentacles. They are: *H. rigida* (May, 1900, p. 80), which bore a label "Mozambique," with no record of depth, *H. capensis* (Hickson, 1900, p. 70), from 20 fathoms of water in False Bay, and *H. uniserta* (Kükenthal, (1906, p. 22), from 70 metres in Simon's Bay. May's specimen was said to be well preserved, and seems to have been fully expanded. The other two were evidently somewhat contracted, and it is possible if they had all been fully expanded some of the recorded differences between them would not have been apparent.

May's specimen which he called *Xenia rigida* must not be confounded with Thomson and Henderson's (1906, p. 413) species of the same name from Zanzibar. It was rather smaller than my specimen, but judging from the figure (May's pl. i, fig. 5), it was clearly dimorphic, although the siphonozooids are called polypbuds (Polypenknospen).

The autozooids attain to a length of 10 mm. and the tentacles to a length of 3 mm. The club-shaped siphonozooids are 4 mm. in height and 0·85 mm. in diameter at the upper end. The spicules are elliptic yellowish-brown scales 0·02 mm. in length.

The original description of *H. capensis* was not very full, but as I have still in my possession, and in good condition, the three series of sections which I made thirty years ago, I can now add a few details which are of importance in view of the controversy which has since arisen. There can be no doubt as to the dimorphism of this series. The differences between the autozooids and siphonozooids are quite as pronounced as they are in *Sarcophytum* or any other dimorphic Alcyonarian. This is shown by a study of the stomodaea of the two kinds of zooids and by other characters. In my original description I said that the siphonozooids are contracted. In my sections I find that some of them project slightly into shallow pits on the surface, and it is probable that when the colony is fully expanded they do project slightly from the general surface. The sections also give some evidence that there may be rudimentary tentacles on the siphonozooids. The autozooids are decidedly smaller (6 mm.) than in *X. rigida*, but the tentacles are longer (4–6 mm.). The spicules are scarce in the coenenchym, absent in the polyps, and rarely more than 0·01 mm. in diameter.

Xenia uniserta of Kükenthal is also undoubtedly dimorphic. The excellent figures and description of the siphonozooids that he gave in his Valdivia report show that there is a striking similarity in structure between them and the siphonozooids of such a genus as *Paragorgia* or of a Pennatulid.

The autozooids are not so retractile as in *H. capensis*, and have a height of 9 mm. The tentacles are 3·7 mm. long, and the siphonozooids do not project from the surface.

Spicules are present throughout the colony, and are much larger (0·057 mm. in length) than in the other species.

These three species form a group which differs from the *H. elisabethae* in having only one row of pinnules on each side of the tentacles. The characters by which they differ from each other are not of sufficient importance to make it certain that they are specifically distinct, and as they all come from the same region it is probable they are only local varieties of one species. At present, however, only four specimens altogether have been described, and the question can only be definitely settled when by the examination of a number of specimens from one locality some idea can be obtained of their variability.

Heteroxenia elisabethae, Kölliker. (Plate I, fig. 1.)

In Ehrenberg's description of his species *Xenia fuscescens* in 1834 (p. 278) no mention is made of the occurrence of dimorphism of the polyps. Klunzinger (1877) reproduced a series of drawings made by Ehrenberg himself which show quite clearly both autozooids and siphonozooids, and said (p. 41) that they were intended for drawings of *X. fuscescens*. These drawings, however, were labelled "fusco-caerulea," not *X. fuscescens*, and all the specimens in the Berlin Museum were labelled "*X. umbellata*"; not a single one was found which was named *X. fuscescens*.

There is really no historical evidence that the type of *X. fuscescens* was dimorphic. Klunzinger said that except in the character of dimorphism *X. fuscescens* agrees with *X. umbellata*, but Kükenthal (1902, p. 642) places *X. umbellata* in a group with long pinnules, 3 in an oblique row, and *X. fuscescens* in a group with 4 pinnules in an oblique row. For reasons given elsewhere, I am convinced that this distinction for species is not sound, and consequently I am of opinion that *X. fuscescens* is a monomorphic form identical with *X. umbellata*.

The Expedition obtained only one specimen of this interesting species. It was found on Wishart's rocks on 23rd May, 1929.

It has a very short thick stalk, which is 10 mm. in height on one side, dwindling to 2 mm. on the other. When the colony was bisected it was found that the stalk is dome-shaped, having a height of 25 mm. in the middle, a maximum diameter of 30 mm. and a diameter at the base of attachment, which appears to be very much contracted, of 20 mm. The spread of the capitulum, including the autozooids, is about 55 mm.

The autozooids show signs of being slightly contracted. The largest of them have a body-length of 15 mm. and a diameter of 1·75 mm. The tentacles are 6 mm. in length, and there are 3 or 4 pinnules in the oblique rows in the middle of the tentacles (see p. 171). There are about 20 pinnules in each longitudinal row.

The pinnules show various degrees of contraction; the largest are pointed at the extremity and 0·6 mm. in length.

The siphonozooids are numerous throughout the capitulum, roughly speaking about five or six times as many as the autozooids. They vary considerably in size, the largest being 9 mm. in height and 1 mm. in diameter. Each siphonozooid has 8 small tentacles about 0·2 mm. in length. These tentacles are folded over the oral area and difficult to observe in whole mounts, but after careful examination and dissection I cannot find any evidence that they bear pinnules.

Spicules are numerous in the autozooids, siphonozooids and stalk. The majority are thin discs having a maximum diameter of 0·025 mm. There are some twins, having a shape like a "cottage" loaf, and some smaller rod-shaped spicules. There are very few that are oval in shape. It seems to be a character of the spicules of this specimen that the outline is more irregular and the shapes more varied than in most of the Xeniids.

Gonads.—The coelenteric cavities of the autozooids bear numerous female gonads of various sizes up to a maximum diameter of about 0·75 mm.

The Genus SYMPODIUM, *Ehrenberg*.

Ehrenberg (1834, p. 285) referred a number of species to this genus, and among them were *S. fuliginosum* and *S. caeruleum* from the Red Sea. Klunzinger (1877, pp. 42, 43) gave a further account of these species and refers to the blue colour of the former. He also described *Anthelia glauca* and *A. strumosa* with a blue-green colour. Kükenthal (1904, pp. 39, 43) described these species more fully, but referred *S. fuliginosum* to the genus *Anthelia* and included *A. glauca* and *A. strumosa* in the same species.

From the descriptions of these authors it seems certain that in all these species the polyps are not retractile, that there are more than the two longitudinal rows of pinnules on the tentacles, and that the spicules, when present, are minute rods or discs. In 1916 Kükenthal announced that in *Sympodium caeruleum* the dorsal mesenteric filaments alone persist and the genus was transferred to the family Xeniidae.

I have found in the Cambridge Museum a small specimen of uncertain locality, but probably from Zanzibar, which agrees very closely with the description given by Kükenthal of *Anthelia fuliginosa*. The polyps are of approximately the same size, and the spicules are of the same size and shape. In this specimen the dorsal mesenteric filaments alone are present. *Anthelia fuliginosa* is therefore undoubtedly a Xeniid, and I see no reason why it should not be referred back to the genus *Sympodium*. In Kükenthal's 'Handbuch der Zoologie' of 1925 *Anthelia* is placed in his family Cornulariidae, but the only difference of any great importance between *Sympodium* and *Anthelia* in his account of these genera in 1916 is that the polyps of the former are more contractile than those of the latter.

I have recently (1930, p. 238) given reasons for suggesting that the generic name "*Anthelia*" should be suppressed.

The genus *Sympodium*, as it now stands, is a Xeniid, and the only character in which it seems to differ from *Xenia* is that the polyps do not form a syndete, but stand apart on a membranous stolon.

In my description of *Xenia nana* (1931, p. 84) I have given reasons for believing that a sympodium-like stage may occur in the development of the Xenias, and that this stage may persist for some time in growth, if there is room on the support for lateral expansion. It is an open question, therefore, whether the species referred to the genus *Sympodium* are not young stages or growth varieties of species of *Xenia*. As this question can only be answered by a special study on the reefs, it may be convenient to retain the genus *Sympodium.*

If this course be adopted a number of species which have been referred to the genus *Clavularia* should be transferred to this genus.

They seem to agree with the Xeniids in having more than one row of pinnules on the tentacles, in having minute spicules or no spicules at all, and in the non-retractile polyps. It is not known, however, whether they have the full number of mesenteric filaments. If it can be proved that they possess the dorsal pair of filaments only, their position is undoubtedly in the family Xeniidae.

In the more typical forms of *Clavularia* there is only one row of pinnules on each side of the tentacles; the spicules, when present, are usually relatively large and often spindle-shaped, and there is a full complement of 8 mesenteric filaments.

Among the species that should now be transferred to the Xeniidae are the following:

Clavularia garciae (Hickson, 1894, p. 341) with rod-shaped spicules. The type-specimen of this species has unfortunately been lost. *C. flava* (May, 1900, p. 43) with oval spicules. *C. gracilis* (May, 1900, p. 41) with no spicules. *C. crosslandi* (Th. & H., 1906, p. 404) with oval spicules. *C. zanzibarensis* (Th. & H., 1906, p. 404) with no spicules. *C. pulchra* (Th. & H., 1906, p. 404) with rod-shaped spicules. *C. mollis* and *C. pregnans* (Th. & H., 1906, pp. 406 and 407) with no spicules. The *Anthelia strumosa* of Ehrenberg was transferred to *Clavularia* by subsequent authors, but according to the accounts of the species given by May and Thomson and Henderson this species must also be a Xeniid. May states that the spicules of his specimen were " Stumpfe Stäbschen," 0·032 mm. in length, but Thomson and Henderson described the spicules as oval or roundish discs, 0·02 × 0·016–0·018 mm.

REFERENCES.

Ashworth, J. H. 1898. The Stomodaeum, Mesenterial Filaments and Endoderm of *Xenia hicksoni.* Proc. Roy. Soc. LXIII, pp. 443–446, figs. 1–3.

—— 1899. The Structure of *Xenia hicksoni*, etc. Quart. J. Micr. Sci. XLII, pp. 245–304, pls. xxiii–xxvii.

—— 1900. Report on the Xeniidae Collected by Dr. Willey. Willey's Zoological Results, Cambridge, pt. IV, pp. 509–530, pls. lii, liii.

Bourne, G. C. 1895. On the Structure and Affinities of *Heliopora coerulea,* Pallas. With some Observations on the Structure of *Xenia* and *Heteroxenia*. Philos. Trans. Roy. Soc. CLXXXVI, B, pp. 455–483, pls. x–xiii.

—— 1900. The Genus *Lemnalia*, Gray. Trans. Linn. Soc. Lond. Zool. (ser. 2), VII, pp. 521–538, pls. xl–xlii.

Brundin, J. A. Z. 1896. Alcyonarien aus der Zoologischen Museums in Upsala. Bih. svensk. Vetensk-Akad. Handl. XXII, Afd. IV, No. 3, pp. 1–22, pls. i, ii.

Cylkowski, B. 1911. Untersuchungen über den dimorphismus bei den Alcyonarien. Inaugural Dissertation, Breslau, pp. 1–47.

Dana, J. D. 1848. U.S. Exploring Expedition: Zoophytes, pp. x + 740, pls. i–lxi.

Ehrenberg, C. G. 1834. Beiträge zur Physiologischen Kenntniss der Corallenthiere. Phys. Abh. K. Akad. wiss. Berlin, 1832 [1834], pp. 225–380.

Haacke, W. 1886. Zur Physiologie der Anthozoen. Zool. Gart. Frankfurt, XXVII, pp. 284–286.

Hickson, S. J. 1883. On the Ciliated Groove (Siphonoglyphe) in the Stomodeum of the Alcyonaria. Philos. Trans. Roy. Soc. (n.s.) CLXXIV, pp. 693–705, pls. l and li.

—— 1894. *Alcyonaria Stolonifera.* Trans. Zool. Soc. Lond. XIII, pp. 325–347, pls. xlv–l.

—— 1900. The Alcyonaria and Hydrocorallinae of the Cape of Good Hope. Marine Investigations in S. Africa, I, pp. 67–96, pls. i–vi.

—— 1903. The Alcyonaria of the Maldives, Part I. Fauna and Geog. Maldives and Laccadives, II, pp. 473–502, pls. xxvi, xxvii.

—— 1930. On the Classification of the Alcyonaria. Proc. Zool. Soc. Lond. 1930, pp. 229–252, text-figs. 1 and 2.

—— 1931. Three Species of Alcyonaria from the Gulf of Manaar. Bull. Madras Govt. Museum (n.s.) Nat. Hist. I, No. 2, pp. 79–89, text-figs. 1–3.

Jungersen, H. F. E. 1892. Ceratocaulon Wandeli en ny nordisk Alcyonide. Vidensk. Medd. naturh. Foren. Kjøb. 1891 [1892], pp. 234–242, text-figs. 1–4.

Kent, W. S. 1893. *See* Saville-Kent, W.

Klunzinger, C. B. 1877. Die Korallthiere des Rothen Meeres. Berlin. Th. 1, pp. 98, 8 pls.

Kölliker, Albert. 1865. Icones Histiologicae, pp. 181, 19 pls.

—— 1875. Die Pennatulide Umbellula und zwei neue Typen der Alcyonarien. Festschr. phys.-med. ges. Würzburg, pp. 1–23, pls. i and ii. (Pt. II. Heteroxenia, pp. 12–17, pl. ii.)

Kükenthal, W. 1902. Versuch einer Revision der Alcyonarien. Die Familie der Xeniiden. Zool. Jahrb. Abt. f. Systematik, XV, pp. 635–662.

—— 1904. Ueber einige Korallentiere des Roten Meeres. Denkschr. med.-naturw. Ges. Jena, XI, pp. 31–58, pls. iv and v, text-figs. 1 and 2.

—— 1906. Alcyonacea. Wiss. Ergebn. Deutschen Tiefsee-Exped. 1898–1899, XIII, Teil 1, pp. 1–111, pls. i–xii.

—— 1911. Alcyonarien von den Aru-und Kei-Inseln. Abh. Senckenb. naturf. Ges. XXXIII, pp. 309–346, pls. xix–xxiii, text-figs. 1–83.

—— 1914. Alcyonaria des Rothen Meeres. Denkschr. Akad. Wiss. Wien, LXXXIX, Berichte der Kommission f. Ozeanographische Forschungen, pp. 1–33, pls. i–iii, text-figs. 1–27.

—— 1916. Die Gorgonarien Westindiens. Kap. 1–3. Zool. Jahrb. Suppl. XI, pp. 443–504, pl. xxiii, 26 text-figs.

—— and Broch, H. 1911. Pennatulacea. Wiss. Ergebn. Deutschen Tiefsee-Exped. 1898–1899, XIII, Teil 1, pp. 113–576, pls. xxiii–xxix, text-figs. 1–295.

Lamarck, J. B. P. A. 1816. Hist. nat. Anim. s. Vertèbres, II, pp. 409–410.

Light, S. F. 1915. Notes on Philippine Alcyonaria. Philipp. J. Sci. X, Section D, pp. 155–167.

Marshall, A. M. 1883. Report on the Pennatulida Dredged by H.M.S. "Triton." Trans. Roy. Soc. Edinb. XXXII, pp. 119–152, pls. xxi–xxv.

May, W. 1900. Beiträge zur Systematik und Chorologie der Alcyonaceen. Jena. Z. Naturw. XXXIII, pp. 1–180, pls. i–v.

Quoy, J. R. C., and Gaimard, J. P. 1883. Voy. "Astrolabe," 1826–29. Zoology, IV, pp. 390, 26 pls.

Saville-Kent, W. 1893. The Great Barrier Reef of Australia. London, pp. xvii + 387, 64 pls. (col.), 1 map, text illust.

Schenk, A. 1897. Clavulariiden Xeniiden, und Alcyoniiden von Ternate. Abh. Senckenb. naturf. Ges. XXIII, pp. 41–80, pls. ii–iv.

Thomson, J. A., and Henderson, W. D. 1905. Alcyonaria. Ceylon Pearl Fisheries Suppl. Reports, Part III, pp. 269–328, pls. i–vi.

—— —— 1906. The Marine Fauna of Zanzibar and British East Africa—Alcyonaria. Proc. Zool. Soc. Lond. 1906, pp. 393–443, pls. xxvi–xxxi, text-fig. 85.

—— and MacQueen, J. M. 1908. Reports on the Marine Biology of the Sudanese Red Sea.—VIII. The Alcyonarians. J. Linn. Soc. Zool. XXXI, pp. 48–75, pls. v–viii, text-figs. 1–4.

Thorpe, L. (Mrs. Hunter). 1928. Alcyonaria of the Abrolhos Islands, Western Australia. J. Linn. Soc. Lond. Zool. XXXVI, pp. 479–531, pls. xxx–xxxiv.

Verrill, A. E. 1869. Critical Remarks on Halcyonoid Polyps. Amer. J. Sci., ser. ii, XLVII, pp. 282–285.

—— 1928. Hawaiian Shallow Water Anthozoa. Bull. B.P. Bishop Museum, XLIX, pp. 1–30, pls. i–v.

Wright, E. P. and Studer, Th. 1889. Alcyonaria. "Challenger" Reports—Zool. XXXI, pp. lxxii, 314, 49 pls., text illust.

Yonge, C. M. 1931. A Year on the Great Barrier Reef. London, pp. xx + 246, 69 pls., 17 text-figs., 6 maps.

APPENDIX.

After this report was written, Sir Arthur Thomson very kindly let me see the proof of the Monograph he is publishing, with the co-operation of Miss I. Dean, on " Some of the Alcyonaria Collected by the ' Siboga ' Expedition."

They record the occurrence of the following species of Xeniidae in the waters of the Malay Archipelago: *Xenia crassa*, *X. florida*, *X. fusca*, *X. garciae*, *X. membranacea*, *X. novae-britanniae*, *X. ternatana*, *X. umbellata*, *X. viridis*, and two species which, in my opinion, should be referred to the genus *Heteroxenia*, namely *H. ashworthi* and *H. capensis*. They also describe a new species of *Cespitularia*, as well as specimens of *C. coerulea* and *C. taeniata*. They record the occurrence of *Sympodium coeruleum* in this region, and the following species attributed to the genus *Anthelia*; *A. garciae*, *A. glauca*, *A. ternatana* and a new species.

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DESCRIPTION OF PLATE I.

All the photographs taken in spirit by Messrs. Hills & Saunders, Cambridge.

FIG. 1.—*Heteroxenia elisabethae*, Kölliker. View of a section through the whole colony showing the long autozooids with tentacles fully expanded and the shorter siphonozooids. The gonads are seen in the cavities of the autozooids.

FIG. 2.—*Cespitularia wisharti*, n. sp. A part of the colony of the type-specimen. This photograph shows polyps arising from the stalk as well as from the capitulum, the characteristic feature of the genus.

FIG. 3.—*Cespitularia mantoni*, n. sp. Seen from above, showing the lobate character of the branches and many of the polyps retracted.

GREAT BARRIER REEF EXPEDITION 1928–29.

Mus. (*Nat. Hist.*). REPORTS, VOL. IV, No. 5. PLATE I.

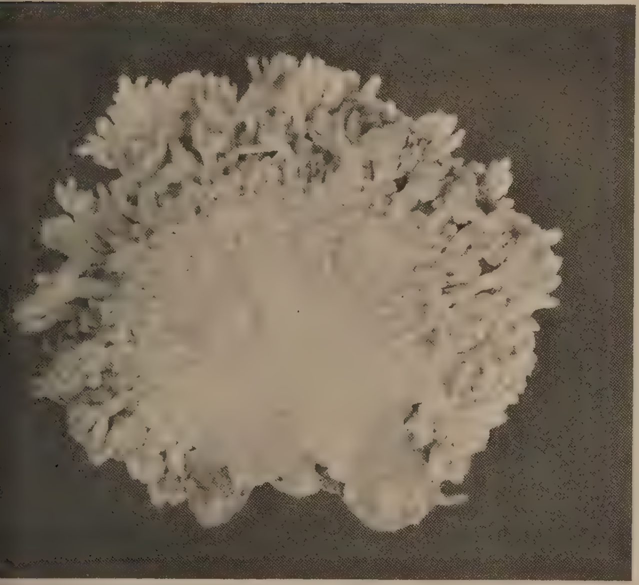

FIG. 1.

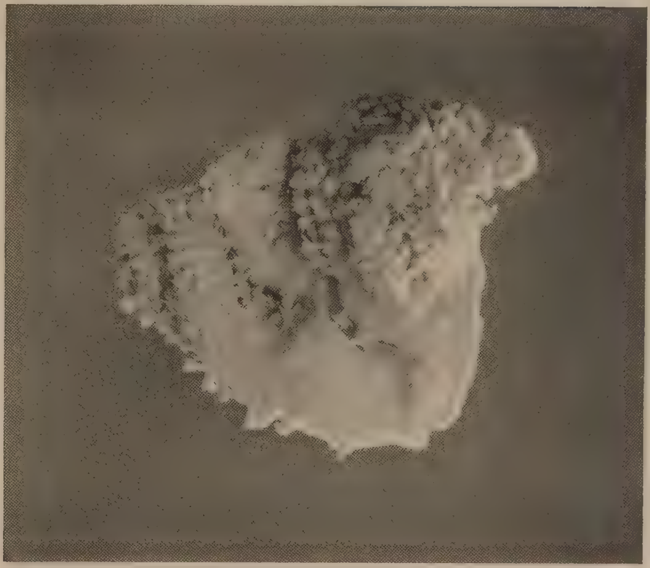

FIG. 2.

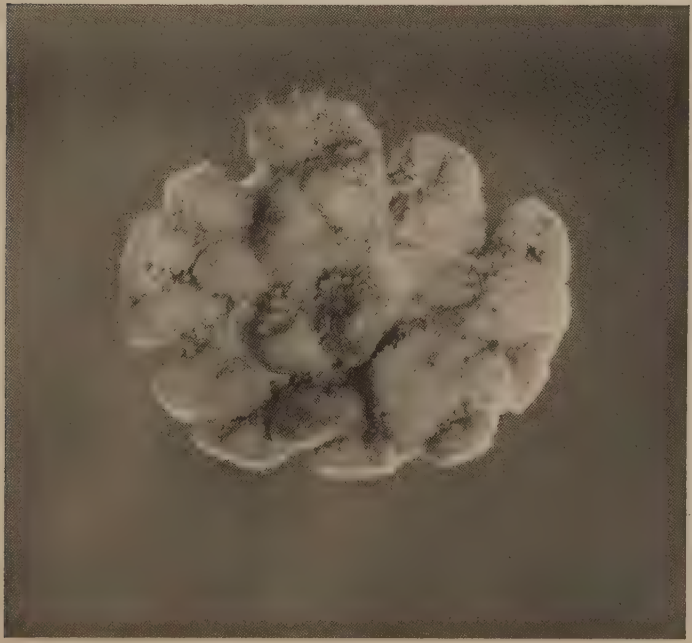

FIG. 3.

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DESCRIPTION OF PLATE II.

All the photographs taken in spirit by Messrs. Hills & Saunders, Cambridge.

FIG. 4.—*Xenia crassa*, Schenk. Specimen R described on p. 161. × 1½ diams.

FIG. 5.—*Xenia plicata*, Schenk. Specimen from Batt Reef described on p. 158. Nat. size. Note that the polyps and tentacles are longer than in *X. crassa*.

FIG. 6.—*Cespitularia multipinnata*, Quoy & Gaimard. A part of the colony of specimen ω from Three Isles.

FIG. 7.—*Cespitularia wisharti*, n. sp. The young specimen from an unknown locality described on p. 166.

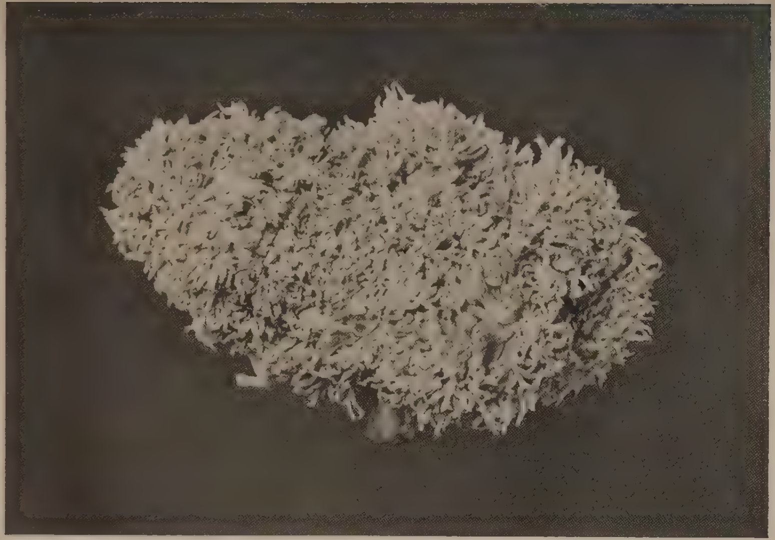

FIG. 4.

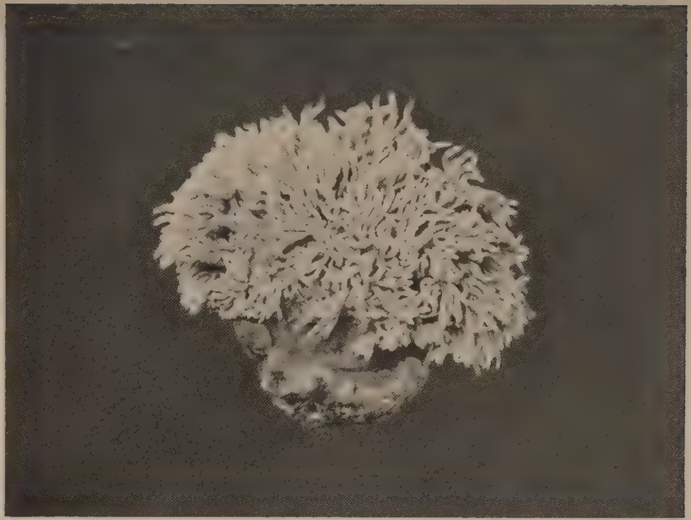

FIG. 5.

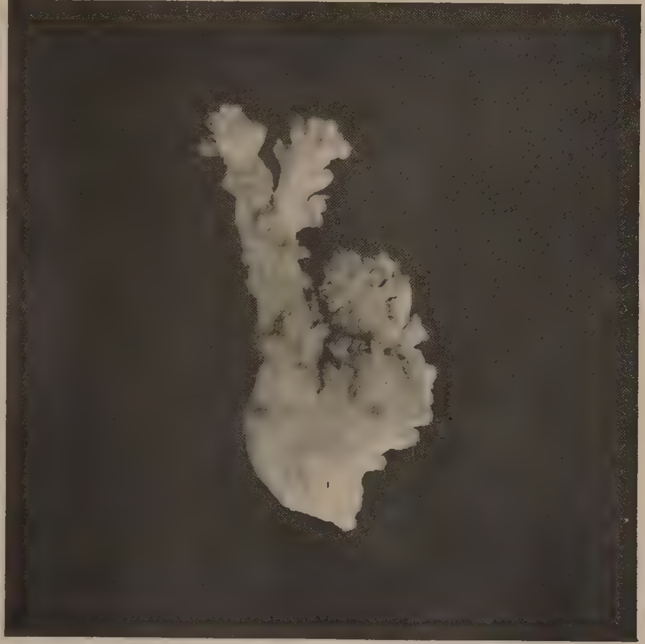

FIG. 6.

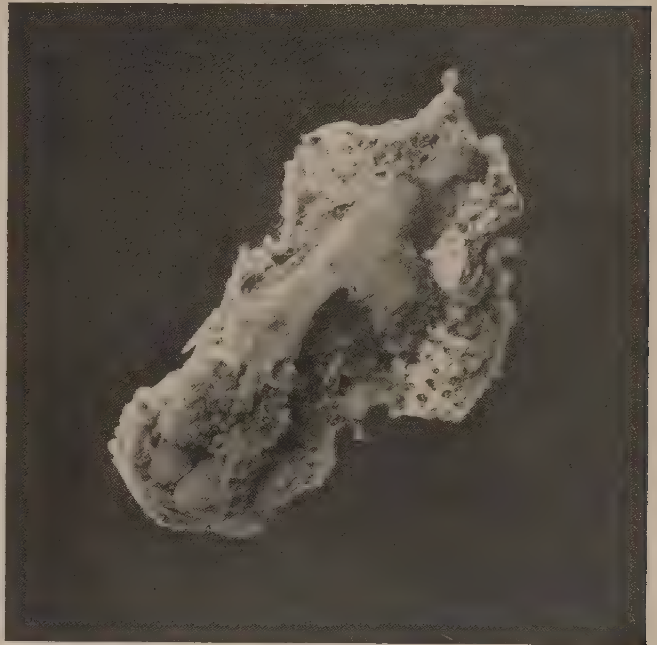

FIG. 7.

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FISH & WILDLIFE SERVICE
BRANCH OF [illegible]
INVESTIGATIONS

HYDROIDA

BY

E. A. BRIGGS, D.Sc., AND VALERIE E. GARDNER, B.Sc.

(From the Department of Zoology, University of Sydney.)

WITH SIX TEXT-FIGURES AND ONE PLATE.

INTRODUCTION.

Our knowledge of the Hydroid Fauna occurring in the warm, shallow waters of Eastern Queensland is based mainly on the works of Bale, supplemented by the reports of Busk, Allman and Kirkpatrick. These authors have described and recorded many species from the islands and bays within the protection of the Great Barrier Reef, which extends from the neighbourhood of Torres Strait along the north-east coast of Australia for a distance of 1250 miles.

Collections of Hydroids from the Great Barrier Reef, however, have been surprisingly few, owing, no doubt, to the difficulties encountered during dredging operations among the coral patches that extend over large areas of the ocean floor in this region.

The Hydroids recorded in the following pages from the Great Barrier Reef represent a small but extremely interesting collection of thirteen species, which were obtained as the result of (1) shore collecting and diving at Low Isles, (2) collecting on the reefs of the Outer Barrier and at Lizard Island, and (3) a series of dredgings carried out at twenty-seven stations along the Queensland coast. Hydroids were secured in seven of these hauls, which were made at depths varying from 4 to 28 fathoms.

The collection contains five species, which are here recorded for the first time from the tropical waters of Eastern Australia, viz.:

Myrionema amboinense, Pictet.
Endocrypta parasitica (Kirk).
Clytia delicatula (Thornely).
Hebella crateroides, Ritchie.
Hincksella sibogae, Billard.

Of special interest is the occurrence of the parasitic Hydroid, *Endocrypta parasitica* (Kirk), on the inner surface of the branchial siphon of a Tunicate (*Polycarpa procera*), which was dredged at Station XXV, Papuan Passage, at a depth of 20 to 25 fathoms. This remarkable Hydroid has previously been recorded only from Tunicates collected in Wellington Harbour, New Zealand, where it was found in the peripharyngeal groove of *Polycarpa* sp., and the stalked Ascidian *Boltenia pachydermatina*.

The hitherto unknown gonosome of *Plumularia longicornis*, Busk, is described and figured, and the species referred to the genus *Halicornaria*.

LIST OF SPECIES.

ATHECATA.

Family Eudendriidae.

*1. *Myrionema amboinense*, Pictet.

Family Clavidae.

*2. *Endocrypta parasitica* (Kirk).

THECATA.

Family Campanulariidae.

*3. *Clytia delicatula* (Thornely).

Family Lafoeidae.

*4. *Hebella crateroides*, Ritchie.

Family Synthecidae.

*5. *Hincksella sibogae*, Billard.

Family Sertulariidae.

6. *Dynamena crisioides*, Lamouroux.
7. *Idiella pristis* (Lamouroux).

Family Plumulariidae.

8. *Polyplumaria cornuta* (Bale).
9. *Thecocarpus angulosus* (Lamarck).
10. *Lytocarpus philippinus* (Kirchenpauer).
11. *Lytocarpus phoeniceus* (Busk).
12. *Halicornaria longicornis* (Busk).
13. *Aglaophenia cupressina*, Lamouroux.

LIST OF STATIONS.

The following is a list of the localities at which Hydroids were collected by the Expedition :

LOW ISLES.

Myrionema amboinense, Pictet.
Clytia delicatula (Thornely).
Dynamena crisioides, Lamouroux.
Lytocarpus philippinus (Kirchenpauer).

LOW ISLES.

Diving Station, No. 1.

Hebella crateroides, Ritchie.
Lytocarpus phoeniceus (Busk).

Outer Barrier ; Ribbon Reef.

Aglaophenia cupressina, Lamouroux.

Outer Barrier ; June Reef.

Aglaophenia cupressina, Lamouroux.

Lizard Island ; Reef A.

Aglaophenia cupressina, Lamouroux.

---

* Indicates that the species is here recorded for the first time from the Great Barrier Reef.

Cape Kimberley, 4 fathoms ; 2nd December, 1928.

Polyplumaria cornuta (Bale).

STATION II.

Linden Bank, 28 fathoms ; bottom, shell and sand ; 24th November, 1928.

Hincksella sibogae, Billard.
Idiella pristis (Lamouroux).
Polyplumaria cornuta (Bale).
Thecocarpus angulosus (Lamarck).

STATION IX.

Penguin Channel, 12 to 14 fathoms ; 22nd February, 1929.

Idiella pristis (Lamouroux).
Thecocarpus angulosus (Lamarck).
Halicornaria longicornis (Busk).

STATION XII.

Penguin Channel, 10 to 15½ fathoms ; bottom, rock and shell gravel ; 24th February, 1929.

Idiella pristis (Lamouroux).
Thecocarpus angulosus (Lamarck).
Halicornaria longicornis (Busk).

STATION XIII.

Half a mile west of Two Isles, 16½ fathoms ; 7th March, 1929.

Idiella pristis (Lamouroux).
Thecocarpus angulosus (Lamarck).

STATION XXII.

East of Snake Reef, 13½ fathoms ; bottom, mud with Foraminifera and shells ; 11th March, 1929.

Thecocarpus angulosus (Lamarck).

STATION XXV.

In Papuan Pass, 20 to 25 fathoms ; bottom, Foraminifera and coral fragments ; 17th March, 1929.

Endocrypta parasitica (Kirk).
Thecocarpus angulosus (Lamarck).

ATHECATA.

Family EUDENDRIIDÆ.

Genus *Myrionema*, Pictet.

TROPHOSOME.—Hydrocaulus well developed, monosiphonic, irregularly branched, surrounded by perisarc. Hydranths long, slender and vase-shaped; hypostome short and slender, distinctly trumpet-shaped; tentacles filiform, very numerous, arising from the base of the hypostome, and arranged in two or three closely appressed rows.

GONOSOME.—Female gonophores of the streptospadiceous type, with the spadix almost completely encircling the ovum; borne on the hydranth in verticils of, typically, from four to six.* Male gonophores chambered, club-shaped, typically two to a hydranth on opposite sides.

GENOTYPE.—*Myrionema amboinense*, Pictet.†

Myrionema amboinense, Pictet. (Plate I, figs. 1–3.)

Myrionema amboinensis, Pictet, Rev. Suisse Zool. I, 1893, p. 19, pl. i, figs. 12, 13; pp. 62–64, pl. iii, figs. 55, 56; *idem*, Svedelius, Svensk. Bot. Tidskr. I, 1907, pp. 32–50, figs. 1–6; *idem*, Stechow, Arch. Naturgesch. LXXXVIII, Abt. A, Heft 3, 1922, p. 145; *idem*, Stechow, Zool. Jahrb. Syst. XLVII, 1923, p. 79.

Eudendrium griffini, Light, Philipp. J. Sci. D, VIII, 1913, pp. 333–356, pls. i and ii; *idem*, Hargitt, Philipp. J. Sci. XXIV, 1924, p. 475.

Many colonies of this extremely interesting Hydroid, which was originally described by Pictet from the Island of Amboina, were collected at Low Isles, where the species forms a very characteristic feature of the flat-life of the lagoon. Our material was gathered in large quantities at low tide, attached to dead coral fragments, to marine grasses and calcareous sea-weeds, and to the roots of mangrove trees.

Pictet's specimens were sterile, and the gonophores remained unknown until 1913, when Light published his description of *Eudendrium griffini* from Bantayan Island in the Philippines. Light's species is identical with *Myrionema amboinense*, Pictet; consequently we have arranged the synonymy as above, retaining *Myrionema* as the generic name, but placing it in the Family Eudendriidæ, instead of the Family Myrionemidæ, which Pictet erected for the accommodation of his new genus and species, *M. amboinense*.

Light's description and figures add many interesting details to Pictet's account, which was based on very scanty material from Batou-Mera, Bay of Amboina.

The specimens collected at Low Isles agree in all respects with the characters of the trophosome and of the gonophores as set out by Light; the dimensions are in complete accord with those given for *E. griffini*; but the account of the process by which the deposition of the ova on the pedicels takes place is not corroborated by the stages present in our specimens. Dr. E. A. Fraser, however, has studied this problem with the aid of living specimens, and her observations and conclusions will form the subject of a separate contribution to our knowledge of the Hydroids from the Great Barrier Reef (see Vol. III, No. 4).

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* Dr. Fraser, in her report on *Myrionema* in Vol. III of this series, figures up to ten.

† Not *amboinensis*: *Myrionema* is neuter gender.

TROPHOSOME.—The details of the trophosome have been worked out by Light, who recognized the differences between the male and female hydranths. The male hydranths (Plate I, fig. 1) are long, slender and vase-shaped ; the sexually immature or sterile female hydranths are similar in appearance to those in the male ; the fertile female hydranths (Plate I, fig. 2) are shortened and thickened, and often atrophied.

The arrangement of the tentacles in two or three closely appressed rows immediately distinguishes this form from the members of the genus *Eudendrium*. The hypostome is trumpet-shaped, and is usually hidden by the long tentacles, which arise from around its base, and extend directly forwards in a dense fringe.

GONOSOME.—Pictet did not observe the gonophores, but these have been fully described by Light. Both male and female gonophores, as well as eggs attached to the pedicels, have been found on the specimens from Low Isles.

The female gonophores are of the streptospadiceous type with the spadix almost completely encircling the ovum, but with the proximal end not recurved or bifurcated; they are borne on the proximal region of the hydranth in verticils of, typically, from four to six.

The male gonophores are chambered, club-shaped structures of rather irregular outline ; they are occasionally bifurcated distally in a vertical plane. There are typically two to a hydranth on opposite sides, slightly below the bases of the tentacles.

Eggs (Plate I, fig. 3) were also observed attached firmly to the perisarc of the pedicels.

ZOOXANTHELLAE.—Great numbers of symbiotic algae (Zooxanthellae) occur throughout the endoderm cells of the coenosarc, gastric cavity, tentacles and gonophores. They are extremely numerous in the endoderm cells of the tentacles, where they form a closely packed layer just within the peripheral walls. Pictet has evidently mistaken these algae for the endoderm cells in the tentacles of *M. amboinense* ; his drawing (plate iii, fig. 56) of a transverse section through a tentacle clearly shows the zooxanthellae, but he failed to detect the walls of the endoderm cells, and consequently believed that the structure of the tentacles was unique among the Hydroids. Light was unable to identify any of the spherical bodies of the ectoderm cells as Zooxanthellae, but a few scattered examples of these symbiotic algae were observed in the ectoderm cells from the coenosarc of our Low Isles specimens.

SYNONOMY.—Light's *Eudendrium griffini* from Bantayan Island, Philippines, is identical with *Myrionema amboinense* ; therefore we have arranged the synonymy as above. Hargitt has also recorded this Hydroid from the Philippine Islands under the name of *E. griffini*.

SYSTEMATIC POSITION.—Pictet erected the Family Myrionemidae to accommodate his new genus and species, *Myrionema amboinense*. We prefer to regard this Hydroid as a primitive member of the Family Eudendriidae, basing this assumption on the characters of the trophosome, as well as on the form of the male and female gonophores. Stechow has expressed the opinion that *M. amboinense* directly connects the Family Eudendriidae with the Clavidae and not with the Bougainvilliidae.

LOCALITY.—Low Isles, Great Barrier Reef. This Hydroid was gathered at low tide in great quantities, attached to dead coral fragments, to marine grasses and calcareous sea-weeds, and to the roots of mangrove trees growing in the lagoon.

DISTRIBUTION.—Previously recorded from Batou-Mera, Bay of Amboina (Pictet) ; Ceylon (Svedelius) ; Bantayan Island, Philippines (Light) ; Philippine Islands (Hargitt). This species is new to the Great Barrier Reef.

Family Clavidae.

Genus *Endocrypta*, Fraser.

Crypta, Fraser, Bull. Labs. Nat. Hist. Univ. Iowa, VI, i, 1911, p. 19.
Endocrypta, Fraser, Trans. Roy. Soc. Canada (3), VIII (Sect. 4), 1914, p. 109.
Ascidioclava, Kirk, Trans. N. Z. Inst. XLVII, 1914 (1915), p. 146.

Genotype.—*Endocrypta huntsmani*, Fraser.

Endocrypta parasitica (Kirk).

Ascidioclava parasitica, Kirk, Trans. N. Z. Inst. XLVII, 1914 (1915), p. 146.

Specimens of this very remarkable parasitic Hydroid occur on the inner surface of the branchial siphon of a Tunicate, *Polycarpa procera* (Sluiter). The characters present in both the trophosome and gonosome are in extraordinarily close agreement with those given for *Ascidioclava parasitica*, which Kirk found in association with Ascidians collected in Wellington Harbour, New Zealand. According to Kirk's account, this Hydroid occurs in the peripharyngeal groove of a species of *Polycarpa*, as well as in the stalked form *Boltenia pachydermatina*.

Fraser has also described, under the name of *Endocrypta huntsmani*, a rather remarkable species found only in the branchial cavity of simple Ascidians dredged in from 5 to 20 fathoms in Departure Bay, Vancouver Island, British Columbia. These Hydroids were not confined to individuals of the same species, since specimens have been discovered in members of the genera *Phallusia*, *Ascidiopsis*, *Ciona* and *Tethyum*.

A comparison of the Barrier Reef specimens with a slide of Fraser's material in the Australian Museum Collection reveals the generic identity of *Ascidioclava* with *Endocrypta*, and since the latter genus has priority, we arrange the synonymy as above, changing the name of Kirk's species to that of *Endocrypta parasitica*.

There is also to be noted a very striking resemblance between the specific characters of these two Hydroids, but in view of the slight differences, which appear to be constant, we prefer to retain *E. parasitica* as a distinct, though closely-related species.

Trophosome.—The hydrocaulus and hydranth together reach a height of nearly 3 mm. In this respect *E. parasitica* differs considerably from *E. huntsmani*, which is a much larger and more robust species, attaining a height of 8 mm.

The hydranth is distinctly club-shaped, with its proximal end narrowing rather abruptly at its junction with the hydrocaulus. In *E. huntsmani* the hydranth passes almost imperceptibly into the hydrocaulus, whose diameter is very slightly less than the greatest width of the hydranth.

The shape of the manubrium varies considerably in the preserved specimens, but the mouth never becomes reflexed entirely, so that it is folded back over the bases of the tentacles, these also being turned backward to point towards the base, as sometimes happens in *E. huntsmani*.

In Kirk's New Zealand specimens the hydrocaulus remained unbranched. We have observed in a single instance a branched hydrocaulus, but the division had taken place just above the hydrorhiza, resulting in the formation of two well-developed hydrocauli. Fraser has described a forked condition, in which the division occurred directly below the bases of the hydranths, so that " the two parts seem to be of equal significance, and seldom differ much in size."

In both species the tentacles have a jointed appearance, due to the arrangement of the nematocysts, which occur in large numbers throughout the ectoderm.

GONOSOME.—The specimens bear developing medusa-buds, either singly or in groups of two, near the base of the hydranth. The most advanced stage is provided with four very short, blunt tentacles. This bud is distinctly campanulate, with a very short stalk. The manubrium is pear-shaped.

SYNONOMY.—Trebilcock* identifies *Ascidioclava parasitica*, Kirk, with *Endocrypta huntsmani*, Fraser. Whilst regarding these Hydroids as congeneric, we have retained Kirk's species and changed the name to *Endocrypta parasitica*.

LOCALITY.—Station XXV, in Papuan Passage, 20 to 25 fathoms; bottom, Foraminifera and coral fragments, 17th March, 1929.

DISTRIBUTION.—Previously recorded only from Wellington Harbour, New Zealand. This species is new to the Great Barrier Reef.

THECATA.

Family CAMPANULARIIDAE.

Genus *Clytia*, Lamouroux.

Clytia delicatula (Thornely).

Clytia sp., Inaba, Zool. Mag. Tokio, 1890, figs. 34, 35.
Obelia delicatula, Thornely, Willey Zool. Res. IV, 1900, p. 453, pl. xliv, fig. 7.
Campanularia delicatula, Jäderholm, Bih. Svensk. Vetensk. Akad. Handl. XXVIII, Afd. 4, No. 13, 1902, p. 3.
Clytia delicatula, Stechow, Abh. Bayer. Akad. Wiss. III Suppl.-Bd., 2 Abh., 1913, p. 65, figs. 20, 21; *idem*, Stechow, Zool. Jährb., Syst. XLVII, 1923, p. 109.

It is with some hesitation that we refer this frail species of *Clytia* to Thornely's *Obelia delicatula*, which was originally collected by Willey in Blanche Bay, New Britain, at a depth of forty fathoms. Thornely's exceedingly brief description omits all reference to the salient features of the gonosome, although gonangia were present with recognizable medusae.

Stechow has identified *Obelia delicatula* Thornely with Inaba's *Clytia* sp. from "Boneri," Bishamon Cove, Sagami Sea. Fortunately Stechow has republished Inaba's excellent description and text-figures, which furnish many details overlooked by Thornely, and enable us to refer the Low Isles specimens with some degree of certainty to *Clytia delicatula* (Thornely). Jäderholm has also recorded this species, under the name of *Campanularia delicatula*, from Japanese waters.

In the specimens before us the characters of the trophosome agree with Inaba's description and figures reproduced by Stechow. The form of the gonangia, however, is not in exact agreement with Inaba's drawings, since the peduncle is somewhat more pronounced in the Low Isles specimens than in those from Japan.

The gonangia arise from the creeping stolon, but in a single instance a gonangium was observed to spring from one of the long peduncles bearing a hydrotheca. Stages in the development of the medusae can be seen in the various gonangia, but the material does not permit of a detailed description of the characters assumed by the fully-formed medusa.

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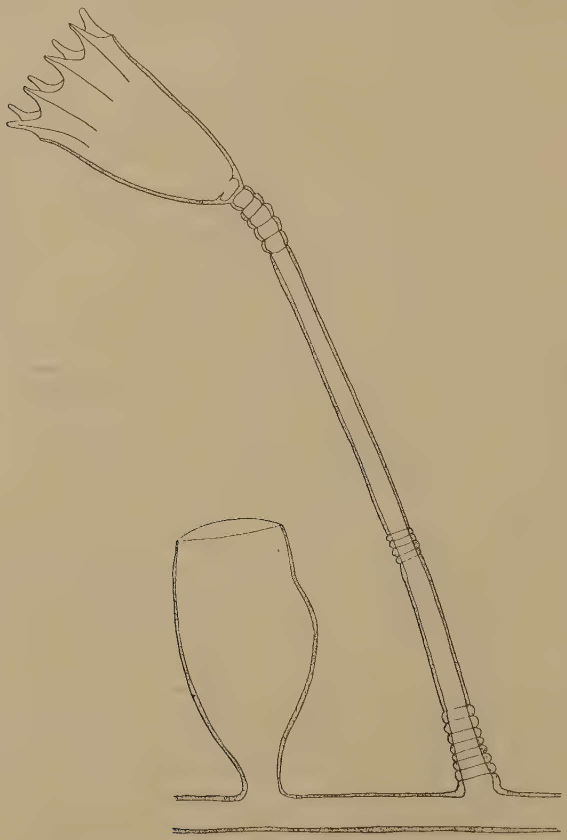
* Trebilcock, Proc. Roy. Soc. Vict., N.S., XLI, 1928, p. 1.

Dimensions.—

Stolon, diameter	0·07–0·09 mm.
Peduncle of hydrotheca, length	Up to 1·8 ,,
,, ,, diameter	0·06–0·07 ,,
Hydrotheca, length	0·49–0·62 ,,
,, diameter at mouth	0·17–0·32 ,,
Gonangium, length	0·64–0·81 ,,
,, greatest diameter	0·24–0·29 ,,



Text-fig. 1.—*Clytia delicatula* (Thornely).

Locality.—Low Isles, Great Barrier Reef. Numerous colonies were found, growing on Sargassum weed collected in the lagoon and along the sandy beach January, 1929.

Distribution.—Previously recorded from "Boneri," Bishamon Cove, Sagami Sea (Inaba); Blanche Bay, New Britain, 40 fathoms (Thornely); Hirudo Strait, Japan (Jäderholm); Sagami Bay, Japan (Stechow); Golden Hind near Niigata, west coast of Hondo, Japan (Stechow). The species is new to the Great Barrier Reef.

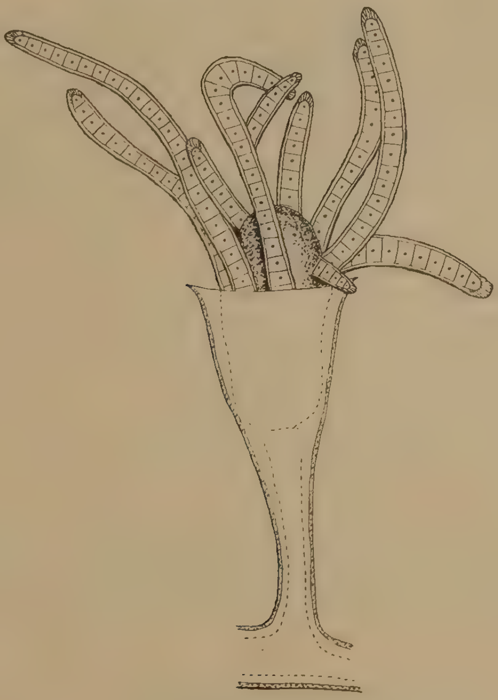
Family LAFOEIDAE.

Genus *Hebella*, Allman.

Hebella crateroides, Ritchie.

Hebella crateroides, Ritchie, Rec. Ind. Mus. V, 1910, p. 6, pl. iv, fig. 1; *idem*, Jarvis, Trans. Linn. Soc. Lond. Zool. XVIII, 1922, p. 336.

A single colony occurs on the stem and branches of a Plumularian Hydroid (*Lytocarpus phoeniceus*) from Diving Station No. 1, Low Isles. From a creeping hydrorhiza there arise here and there small colourless hydrothecae with gracefully everted margins. These hydrothecae are somewhat larger than those originally described from the Andaman Islands. The hydranths bear from ten to eleven tentacles, whereas Ritchie's specimens had about six to eight tentacles.



TEXT-FIG. 2.—*Hebella crateroides* (Ritchie).

Gonosome absent.

DIMENSIONS.—	Barrier Reef specimens.	Andaman Islands specimens.
Hydrotheca, length	0·42–0·45 mm.	0·36–0·39 mm.
,, diameter at mouth	0·18–0·20 ,,	0·18–0·21 ,,

LOCALITY.—Growing on *Lytocarpus phoeniceus* from Diving Station No. 1, Low Isles, Great Barrier Reef.

DISTRIBUTION.—Previously recorded from Andaman Islands, 270 to 45 fathoms (Ritchie); Farquhar Atoll (Jarvis). This species is new to the Great Barrier Reef.

Family SYNTHECIIDAE.

Genus *Hincksella*, Billard.

Hincksella, Billard, Arch. Zool. Exp. Gén., Notes et Revue, LVII, 1918, p. 22; *idem*, Billard, Les Hydroides de l'Exped. du Siboga, VII*b*, 2, Synthecidae et Sertularidae, 1925, p. 121.

Hincksella sibogae, Billard.

Hincksella sibogae, Billard, Arch. Zool. Exp. Gén., Notes et Revue, LVII, 1918, p. 23, fig. 2; *idem*, Billard, Les Hydroides de l'Exped. du Siboga, VII*b*, 2, Synthecidae et Sertularidae, 1925, pl. 122, p. vii, fig. 1, and text-fig. 1*a–e*.

A solitary colony, 57 mm. in height, alone represents this species from Station II. The main stem, which is fascicled at the base, is denuded of its branches for a length of 38 mm.; the distal 19 mm. bear nine alternate branches. The characters of the trophosome are in complete agreement with those described by Billard. The shape of the hydrothecae is very characteristic; each has a regular circular margin, without a trace of operculum. The hydrotheca attains its greatest diameter at the mouth, and gradually narrows towards the base. The adcauline wall is adnate for the greater part of its length, the free moiety consequently being very short.

Gonosome absent.

DIMENSIONS.—	Barrier Reef specimen.	Siboga specimen.
Hydrotheca, length . . .	0·24–0·26 mm.	0·21–0·24 mm.
,, diameter at mouth	0·29–0·31 ,,	0·26–0·28 ,,

LOCALITY.—Station II, Linden Bank, 28 fathoms; bottom, shell and sand; 24th November, 1928.

DISTRIBUTION.—Hitherto recorded only from "Siboga" Station 49A in 8° 23·5′ S., 119° 4·6′ E.; Détroit de Sapeh, 69 m.; "Siboga" Station 65A, Très près de la Station 65, dont la latitude et la longitude sont 7° 0′ S., 120° 34·5′ E., 3–400 m. (Billard). This species is new to the Great Barrier Reef.

Family SERTULARIIDAE.

Genus *Dynaemna*, Lamouroux.

Dynamena crisioides, Lamouroux.

Dynamena crisioides, Lamouroux, Des. Polyp. Flex., in Quoy et Gaimard, Voyage . . . l'Uranie et la Physicienne Zool. 1824, p. 613, pl. 90, figs. 11, 12; *idem*, Billard, Les Hydroides de l'Exped. du Siboga, VII*b*, Synthecidae et Sertularidae, 1925, p. 181, pl. vii, fig. 21, text-figs. xxxvi–xxxvii.

Dynamena tubuliformis, Marktanner-Turneretscher, Ann. Naturh. (Mus.) Hofmus. Wien, V, 1890, p. 238, pl. iv, fig. 10.

Thuiaria tubuliformis, Briggs, Rec. Aust. Mus. XII, 1918, p. 38 (references).

Many specimens of this typical, tropical species, the largest 22 mm. in height, were collected at Low Isles, where it proved to be the most frequently-occurring Hydroid on the reef. The colonies were usually found attached to the sides and bases of dead coral blocks left exposed, often for considerable periods, at low tide.

Gonosome.—Gonangia of characteristic form were present on many of the colonies collected during the month of January, 1929.

Synonomy.—We have assigned these specimens to *Dynamena crisioides*, following Billard, whose examination of Lamouroux's type has established the identity of Marktanner-Turneretscher's *D. tubuliformis* with *D. crisioides*.

Locality.—Low Isles, Great Barrier Reef.

Genus *Idiella*, Stechow.

Idia, Lamouroux, Hist. Polyp. Cor. Flex. 1816, p. 199 (name preoccupied).
Idiella, Stechow, Zool. Jährb., Syst. Bd. XLII, 1919, p. 106.

Idiella pristis (Lamouroux).

Idia pristis, Lamouroux, Hist. Polyp. Cor. Flex. 1816, p. 200, pl. v, figs. AA, B, C, D, E; *idem*, Bale, Cat. Austr. Hyd. Zooph. 1884, p. 113, pl. vii, figs. 1, 2; pl. xix, fig. 33.
Diphasia rectangularis, Lendenfield, Proc. Linn. Soc. N.S. Wales, IX, 1885, p. 914, pl. xli, figs. 6–8.

The colonies of this widely-distributed species agree in detail with Bale's description and figures of other Australian specimens, except that the slight angular ridge extending along the front of the hydrotheca, from the base to the aperture, is generally absent.

Localities.—Station II, Linden Bank, 28 fathoms; bottom, shell and sand; 24th November, 1928. Station IX, Penguin Channel, 12 to 14 fathoms; 22nd February, 1929. Station XII, Penguin Channel, 10 to 15½ fathoms; bottom, rock and shell; 24th February, 1929. Station XIII, half a mile west of Two Isles, 16½ fathoms; 9th March, 1929.

Family Plumulariidae.

Genus *Polyplumaria*, Sars.

Polyplumaria cornuta (Bale).

Plumularia cornuta, Bale, Cat. Austr. Hyd. Zooph. 1884, p. 132, pl. xi, figs. 1, 2.
Polyplumaria cornuta, Billard, Les Hydroides de l'Exped. du Siboga, VII*a*, I, Plumulariidæ, 1913, p. 53, pl. iii, fig. 33; pl. iv, figs. 35, 36.

Two specimens, the larger reaching a length of 45 cm., represent this rather variable species originally described by Bale from an incomplete colony two feet in height. The characters of the trophosome are similar to those enumerated in Billard's extended description, which supplements Bale's account of the distribution of the sarcothecae and the structure of the aborted secondary hydrocladia.

Dimensions.—

Hydrocladium, length	Up to 8 mm.
Hydroclade internode, length	0·34–0·37 ,,
Secondary hydrocladium, length	0·49–0·60 ,,
Hydrotheca, depth	0·17 ,,
,, breadth at mouth	0·10–0·12 ,,

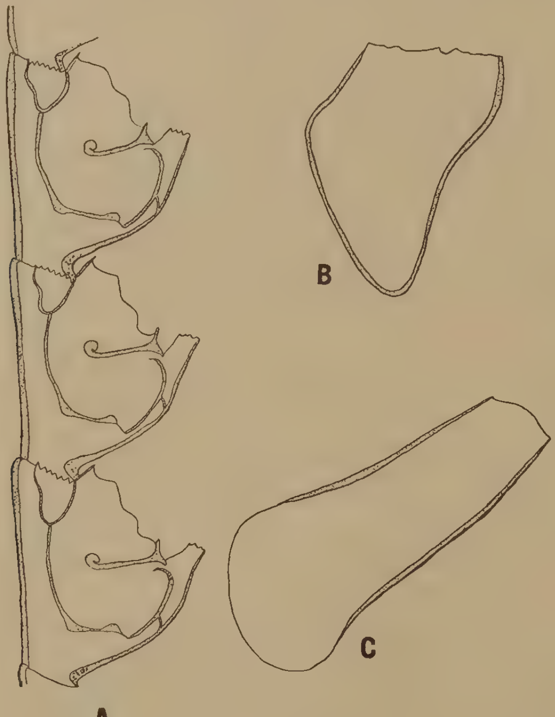
Localities.—Station II, Linden Bank, 28 fathoms; bottom, shell and sand; 24th November, 1928. Quarter of a mile south of Cape Kimberley, 4 fathoms; 2nd December, 1928.

Distribution.—Previously recorded from Port Molle, 15 fathoms; Port Denison; and Holborn Island, 20 fathoms, Queensland (Bale). The "Siboga" Expedition secured numerous specimens of this species at sixteen stations in the East Indies, at depths ranging from 9 to 216 metres (Billard).

Genus *Thecocarpus*, Nutting.

Thecocarpus angulosus (Lamarck).

Plumularia angulosa, Lamarck, Hist. Nat. des Anim. sans Vert. II, 1816, p. 126.
Thecocarpus angulosus, Billard, Les Hydroides de l'Exped. du Siboga, VII*a*, I, Plumulariidæ, 1913, p. 85, figs. lxx–lxxiv (synonymy).
Acanthocladium angulosum, Stechow and Müller, Abh. Senckenb. Naturf. Ges. XXXV, 1923, p. 476.



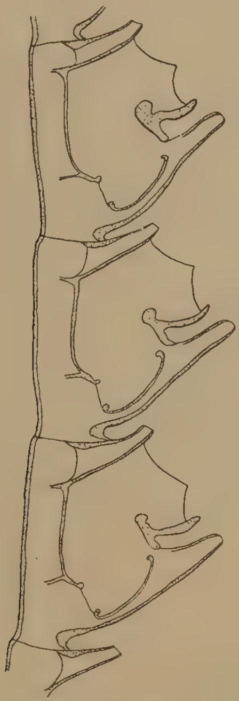
Text-fig. 3.—*Thecocarpus angulosus* (Lamarck). A. Hydrothecae. B. Lateral sarcotheca from a hydrotheca situated near the distal extremity of a hydrocladium. C. Lateral sarcotheca from a hydrotheca situated near the proximal end of a hydrocladium.

Numerous colonies of this exceedingly variable species were obtained in the dredge at six different stations, at depths ranging from 10 to 28 fathoms. The form of the hydrothecae approaches closest to the drawing (fig. lxx, c) given by Billard in his "Siboga" Report for a specimen from Station 164. In the specimens before us, a small septum runs across the cavity of the mesial sarcotheca. This structure is apparently wanting in the "Siboga" specimens, although Billard's figures indicate a thickening of the perisarc at the point where this partition occurs in the Barrier Reef forms of *T. angulosus*.

The lateral sarcothecae display a very wide range of variation ; those accompanying a hydrotheca situated near the distal extremity of a hydrocladium are short and broad, with a distinctly crenulated margin, but a gradual change in shape takes place, until in the proximal portion of the hydrocladium they have become drawn out into long tubular structures.

Gonosome.—Corbulae, up to 8 mm. in length, occur on several of the colonies. They are of the open type, consisting of ten to eleven pairs of separate corbula-leaves, and carry a series of gonangia in the form of ovate bodies with extremely short peduncles for attachment.

Localities.—Station II, Linden Bank, 28 fathoms ; bottom, shell and sand ; 24th November, 1928. Station IX, Penguin Channel, 12 to 14 fathoms ; 22nd February, 1929. Station XII, Penguin Channel, 10 to 15½ fathoms ; bottom, rock and shell ; 24th February, 1929. Station XIII, half a mile west of Two Isles, 16½ fathoms ; 7th March, 1929. Station XXII, east of Snake Reef, 13½ fathoms ; bottom, mud with Foraminifera and shells ; 11th March, 1929. Station XXV, in Papuan Passage, 20 to 25 fathoms ; bottom, Foraminifera and coral fragments ; 17th March, 1929.



Text-fig. 4.—*Lytocarpus philippinus* (Kirchenpauer).

Genus *Lytocarpus*, Allman.

Lytocarpus philippinus (Kirchenpauer).

Aglaophenia philippina, Kirchenpauer, Abh. Natur. Hamburg, V, Abt. 3, 1872, p. 45, pls. i, ii, vii, fig. 26.
Aglaophenia urens, Kirchenpauer, Abh. Natur. Hamburg, V, Abt. 3, 1872, p. 46, pls. i, ii, vii, fig. 27.
Lytocarpus phillipinus, Bale, Proc. Roy. Soc., Vict. XXXI (n.s.), 2, 1919, p. 351 (synonymy).
Macrorhynchia philippina, Stechow and Müller, Abh. Senckenb. Naturf. Ges. XXXV, 1923, p. 475.

A number of small colonies, the largest not exceeding 28 mm. in height, were collected on the branches of dead corals taken from the Moat, Low Isles. The specimens possess similar trophosome characters to those described by Bale, except that the hydrothecae have distinct lateral lobes with definite embayments between them.

Gonosome absent.

Colour in life, pale blue.

DIMENSIONS.—

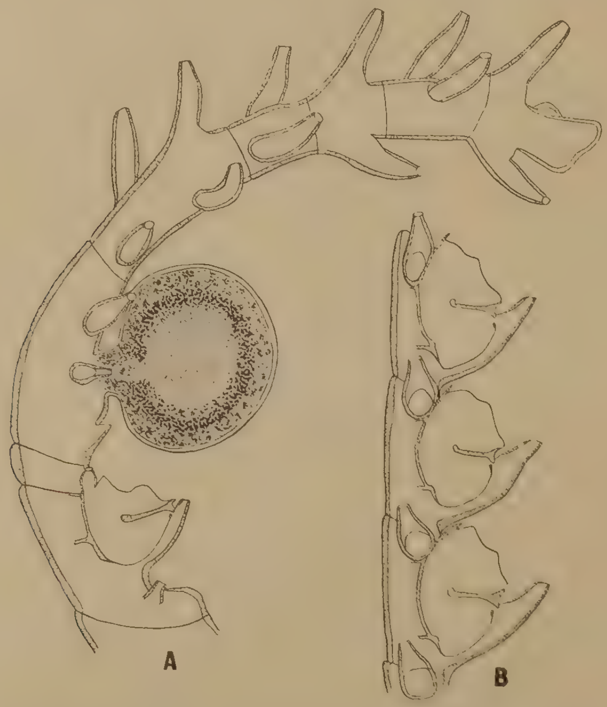
Hydrocladium, length	up to 4 mm.
Hydroclade internode, length	0·30–0·33 ,,
Hydrotheca, depth	0·25–0·28 ,,
,, breadth at mouth	0·12–0·14 ,,

LOCALITY.—The Moat, Low Isles, Great Barrier Reef; 19th March, 1929, and 20th May, 1929.

Lytocarpus phoeniceus (Busk).

Plumularia phoenicia, Busk, Voy. of "Rattlesnake," Edited by J. Macgillivray, I, 1852, p. 398.

Aglaophenia phoenicea, Bale, Cat. Austr. Hydr. Zooph. 1884, p. 159, pl. xv, figs. 1–5; pl. xvii, figs. 1–4; pl. xix, fig. 31.



TEXT-FIG. 5.—*Lytocarpus phoeniceus* (Busk). A. Modified hydrocladium bearing lenticular gonangium and two rows of sarcothecae. B. Hydrothecae.

The collection contains several specimens of *Lytocarpus phoeniceus*, which were collected at Diving Station No. 1, Low Isles. The characters of the trophosome most nearly resemble those in Bale's figure (pl. xv, fig. 5) of a variety from Gloucester Passage, Queensland.

GONOSOME.—The colonies carry typical, lenticular gonangia, each of which is attached to a modified hydrocladium, armed with two rows of long sarcothecae. The proximal internode of the hydrocladium bears a hydrotheca with a very reduced mesial sarcotheca.

LOCALITY.—Diving Station No. 1, Low Isles, Great Barrier Reef; 19th May, 1929.

Genus *Halicornaria*, Busk.

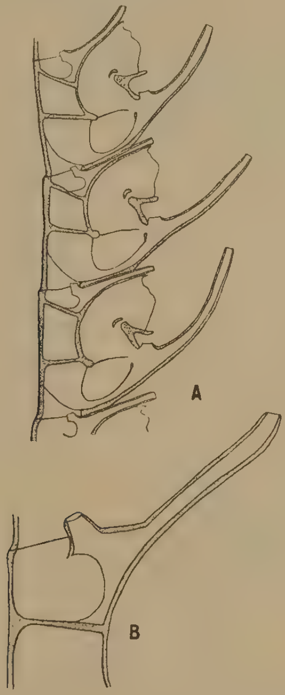
Halicornaria longicornis (Busk). (Plate I, fig. 4.)

Plumularia longicornis, Busk, Voy. "Rattlesnake," Edited by J. Macgillivray, I, 1852, p. 399.

Aglaophenia longicornis, Kirchenpauer, Abh. Ver. Hamb. V, Abt. 3, 1872, p. 47, pls. i and vii, fig. 28; *idem*, Bale, Cat. Austr. Hyd. Zooph. 1884, p. 157, pl. xiv, figs. 7, 8; pl. xvii, fig. 5; *idem*, Marktanner-Turneretscher, Ann. naturh. (Mus.) Hofmus. Wien, V, 1890, p. 267; *idem*, Kirkpatrick, Proc. Roy. Dublin Soc., 1890, p. 604.

Lytocarpus longicornis, Bedot, Rev. Suisse Zool. XXVIII, 1921, pp. 315, 321.

Macrorhynchia (?) *longicornis*, Stechow and Müller, Abh. Senckenb. Naturf. Ges. XXXV, 1923, p. 474.



TEXT-FIG. 6.—*Halicornaria longicornis* (Busk). A. Hydrothecae. B. Lateral sarcotheca.

The colony from Station IX is yellowish-white in colour and reaches a height of 6 cm. The specimens from Station XII are much darker in colour, due to the presence of black or very dark brown pigment-granules in the cells of the coenosarc and in the tissues of the hydranths. The largest colony from this station attains a height of 19 cm., while two other specimens from the same locality measure 13 and 14 cm. in height respectively.

The macroscopic appearance of this Hydroid and the structure of the trophosome have been fully described by Bale and other writers, but the gonangia have always escaped observation, even when fully-grown specimens have been available for examination.

Two of the colonies from Station XII are of extreme interest, since they bear mature gonangia. The presence of these structures enables us to describe and figure the gonosome for the first time.

Gonosome.—The gonangia are carried on the front of the branches between the bases of the hydrocladia. They form a row of fan-shaped receptacles along the branch, each one springing from a mammiliform process, which bears also a hydrocladium and two cauline sarcothecae.

The gonangium, when viewed in its broader aspect, exhibits a very short peduncle arising from a mammiliform process of the branch. Above the point of attachment the walls of the gonangium (Plate I, fig. 4) rapidly diverge, forming a fan-shaped structure, which reaches a breadth of 0·35 to 0·37 mm. The distal extremity of the gonangium is markedly convex. In side view the gonangium appears extremely thin and compressed, with a width of only 0·09 to 0·11 mm.

Dimensions.—

Gonangium, length	0·48–0·53 mm.
,, breadth in frontal aspect . . .	0·35–0·37 ,,
,, ,, lateral aspect . . .	0·09–0·11 ,,

Localities.—Station IX, Penguin Channel, 12 to 14 fathoms; 22nd February, 1929. Station XII, Penguin Channel, 10 to $15\frac{1}{2}$ fathoms; bottom, rock and shell; 24th February, 1929.

Distribution.—Previously recorded from Torres Straits (Busk); Singapore (Kirchenpauer); Fitzroy Island and Albany Passage, Queensland (Bale); Port Jackson, N.S. Wales (Marktanner-Turneretscher); Aru Islands (Stechow and Müller).

Genus *Aglaophenia*, Lamouroux.

Aglaophenia cupressina, Lamouroux.

Aglaophenia cupressina, Lamouroux, Hist. Polyp. Cor. Flex. 1816, p. 169; *idem*, Bale, Biol. Res. "Endeavour," III, 1915, p. 319, pl. xlvii, figs. 6–8 (synonymy).

Three colonies, the largest attaining a height of 15 cm., represent this characteristic, reef-inhabiting species.

Gonosome.—Immature corbulae are present on the specimens.

Localities.—Lizard Island, Reef A; 3rd June, 1929. Ribbon Reef, Outer Barrier; 4th June, 1929. June Reef, Outer Barrier; 6th June, 1929.

Distribution.—This species has previously been recorded by Bale from the Great Barrier Reef at North-West Island, off Port Curtis, Queensland. Billard's "Siboga" Report discusses the distribution of this species, which has been described under various synonyms from many widely-separated localities in the Indian and Pacific Oceans. More recently Hargitt (Philipp. J. Sci. Manila, XXIV, 1924) has recorded this Hydroid as *Aglaophenia macgillivrayi* (Busk) from the reefs near Mindanao, Philippine Islands, at a depth of 8 to 10 fathoms.

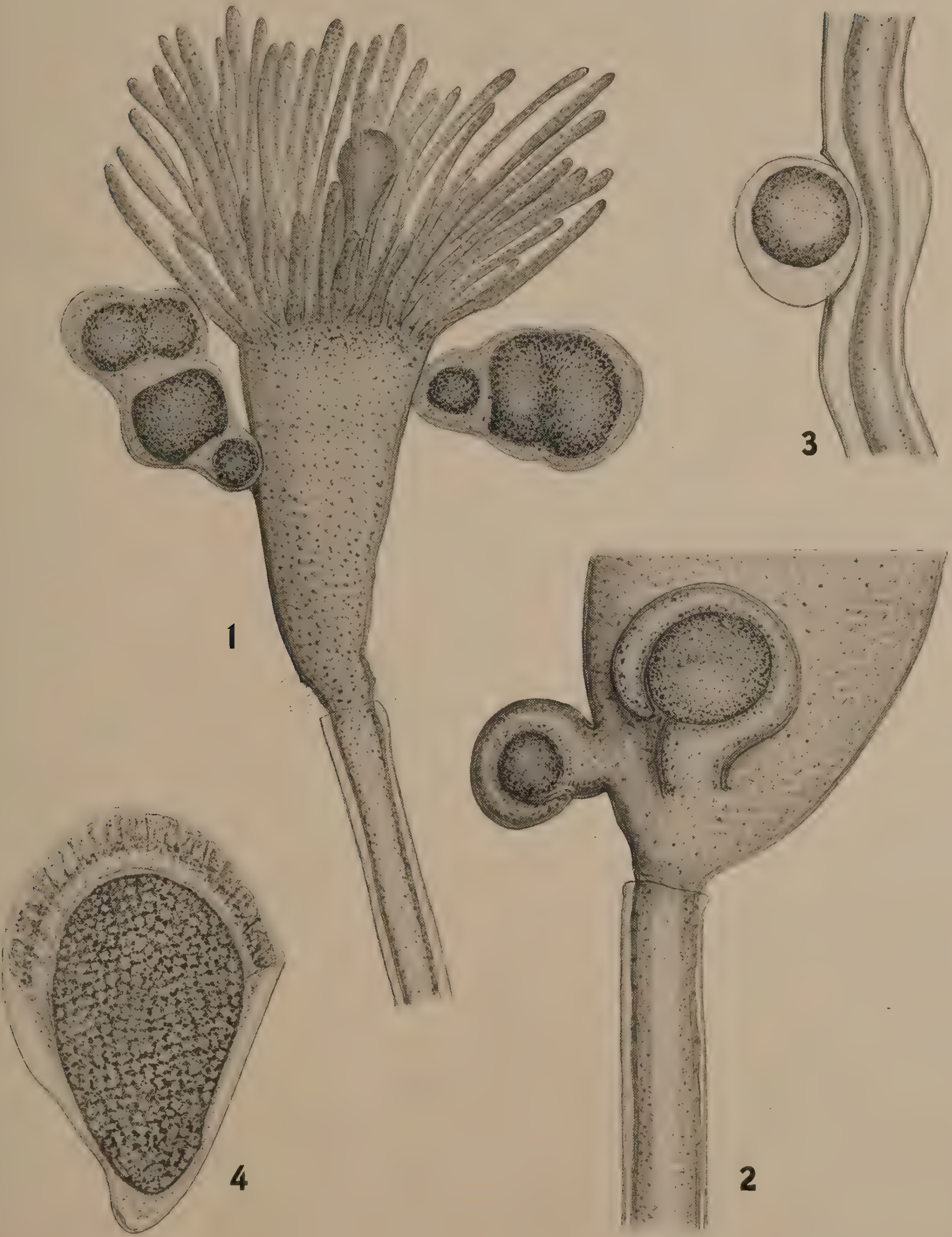
PLATE I.

Fig. 1.—*Myrionema amboinense*, Pictet. Hydranth bearing male gonophores.

Fig. 2.—*Myrionema amboinense*, Pictet. Proximal end of hydranth with female gonophores.

Fig. 3.—*Myrionema amboinense*, Pictet. Egg attached to pedicel.

Fig. 4.—*Halicornaria longicornis* (Busk). Gonangium in frontal aspect.



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INVESTIGATIONS

ECHINODERMATA

(OTHER THAN ASTEROIDEA)

BY

HUBERT LYMAN CLARK
(Museum of Comparative Zoölogy, Cambridge, Mass.)

WITH NINE TEXT-FIGURES AND ONE PLATE

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INTRODUCTION.

The collection of echinoderms made by the Great Barrier Reef Expedition seems to be very representative of the area where it was obtained. As sent to me, it lacks the sea-stars, a report on which is being prepared by my friend and colleague, Mr. Arthur A. Livingstone, of the Australian Museum.

The collection examined by me contains more than five hundred specimens, representing 117 species and varieties and 66 genera. While only four species and one variety require description as new, the additions to the Australian fauna and the extensions of geographical range are of very real importance, so that it can fairly be said that the work of the Great Barrier Reef Expedition has added much to our knowledge of Australian echinoderms. Six genera and 14 species are here listed for the first time from that region, while five additional species were not known hitherto from Queensland. But it should be noted that five of the six genera were taken only in the deep-water dredgings at St. XV, 210 fms. Very little such dredging has been done off the Queensland coast, and hence it is not surprising that these hauls should have proved so remunerative. Further analysis of the collection will be found in the introductory paragraph, under each of the four classes.

CRINOIDEA.

The collection of crinoids contains 56 specimens of 18 species, representing 11 genera, all comatulids. None of the species is new to science, but two, *Comatella nigra* and *Iconometra anisa*, have not previously been reported from south of the Murray Islands. Only a dozen species were taken in the Low Isles neighbourhood, the other six coming from the vicinity of Lizard Island. The best collecting would seem to have been in the latter region, where at St. XIV half a dozen species were taken, of which three were not found at Low Isles.

My friend, Mr. Austin Hobart Clark, of the United States National Museum, the recognized authority on crinoids, has been most kind in examining some of the perplexing specimens and giving me the benefit of his wide experience and expert knowledge. It is a pleasure to thank him here for his generous help.

Comatella nigra (Carpenter).

Actinometra nigra, P. H. Carpenter, 1888, Voy. "Challenger," XXVI, pt. 60, Crinoidea, 2, p. 304.
Comatella nigra, A. H. Clark, 1908, Smithson. Misc. Coll. LII, p. 207.

There are five specimens, much alike in size, colour and number of arms, from St. XIV, 19 fms. In life they were "purple, distal ends of arms yellow." In alcohol they are uniformly deep purple, 200–225 mm. in diameter and have about 43 arms; cirri 16–18, with 26–29 segments. The occurrence of *nigra* near Lizard Island extends the known range of the species a little to the south.

Comatula pectinata (Linnaeus).

Asterias pectinata, Linnaeus, 1758, Syst. Nat. ed. X, p. 663.
Comatula pectinata, A. H. Clark, 1908, Proc. U.S. Nat. Mus. XXXIII, p. 685.

There are eight specimens of this common species. One is a fine individual from St. XXII, 13½ fms., while three notable specimens with arms 150 mm. long or more were taken at St. IX, 12–14 fms. These three were, in life, "red with white markings." Two specimens from St. XII, taken with *Amphimetra jaquinoti*, were also red and white. The other two specimens are from St. XIV, 19 fms. It is interesting that no specimens of the small, perhaps depauperate form of *pectinata*, known as *purpurea*, were taken by the Expedition, for that form is very common at the Murray Islands (where typical *pectinata* is rare), and has been taken as far south as Port Denison. Judging from the "Key Chart of Low Isles," one would certainly expect to find *purpurea* at several places, especially on the western side.

Comatula rotalaria, Lamarck.

Lamarck, 1816, Anim. s. Vert. II, p. 534.

There is a single specimen with 20 arms well over 150 mm. long. There are no cirri, and the dorsal apex is perfectly smooth, but the oral surface of the disk is covered with projecting, fleshy, tubercle-like prominences, which are wanting in the specimens of *solaris* from the same place, St. XIV, 19 fms.

Comatula solaris, Lamarck.

Lamarck, 1816, Anim. s. Vert. II, p. 533.

There are five specimens of this fine species, of which four were taken at St. XIV, 19 fms., and one at St. IX, 12–14 fms. The cirri are few, with only 15 or 16 segments. The arms are 125–150 mm. long and range from moderately to very stout (4½ mm. wide). The colour is very diverse, no two of the specimens being alike; one is uniformly dark purple, another is dirty brown with pinnules yellow, another "yellow with pinnules brown, edged with white," and another "grey, white striped" (a white longitudinal stripe on dorsal side of arm).

Comantheria alternans (Carpenter).

Actinometra alternans, P. H. Carpenter. 1881, Notes Leyden Mus. III, p. 208.
Comantheria alternans A. H. Clark, 1911, Notes Leyden Mus. XXXIII, p. 176.

Two large comatulids from St. IX, 12–14 fms., with about 43 arms, 150–170 mm. long, seem nearer to this species than to any other, but they are certainly not typical specimens. They might be referred equally well to *C. polycnemis*, A. H. Clark, but as that species is not known from south of the Kei Islands, it seems better to call them *alternans*. The disks are very large, the discarded visceral mass measuring 34 by 22 mm. The II Br. series are 4 (3 + 4), or rarely 2; III Br. series, 2; IV Br. series, when present, 2; but there are altogether only three or four IV Br. series visible. Cirri are wanting in one specimen; in the other, 5 or 6 weak ones are present, but all are broken; they have segments 4, 5 and 6 markedly longer than wide, cylindrical and smooth, and are obviously different from those of *briareus*. The general appearance of these specimens is stouter than that of *briareus*, and resembles closely that of *alternans* from the Murray Islands. The colour is uniformly bright brown, except for being more yellow at distal points.

Comanthus timorensis (J. Müller).

Alecto timorensis, J. Müller, 1841, Mber. K. Preuss. Akad. Wiss. p. 186.
Actinometra annulata, Bell, 1882, Proc. Zool. Soc. Lond. p. 535, pl. xxxv.
Comanthus timorensis, A. H. Clark, 1931, Bull. U.S. Nat. Mus. LXXXII, I, pt. 3, p. 159 (603), pl. lxiv, fig. 181; pl. lxxv, fig. 204; pl. lxxvi, fig. 205; pl. lxxvii, figs. 206, 207.

There are only four specimens of this common Australian comatulid in the collection. They are very much alike, about 200 mm. across in life, and of a deep olive-brown colour. All are from Anchorage Reefs, Low Isles.

Comanthus bennetti (J. Müller).

Alecto bennetti, J. Müller, 1841, Mber. K. Preuss. Akad. Wiss. p. 187.
Comanthus bennetti, A. H. Clark, 1909, Vidensk. Medd. naturh. Foren. Kjöb. p. 147.

There is a single young individual in the collection from St. XVII, 19 fms. The more mature of the 30 arms are 90–100 mm. long; 10 of the arms, in five pairs, are very young. There are 18 cirri with 21–27 segments, not very unlike those of an adult. The colour is a dull olive-brown, in some areas with a distinctly bluish cast; the longer arms have a broad, longitudinal whitish band on the distal third. The cirri are yellow and the very young arms are cream-yellow.

Comanthus parvicirra (J. Müller).

Alecto parvicirra, J. Müller, 1841, Mber. K. Preuss. Akad. Wiss. p. 185.
Comanthus parvicirra, A. H. Clark, 1908, Smithson. Misc. Coll. LII, p. 203.

To this widespread, common, but imperfectly understood comatulid I am referring fourteen specimens, several of which are really too young for specific determination, but most probably belong here. At present we do not know how to distinguish young *parvicirra* from young *timorensis*. Several of the specimens are so damaged that the number of arms cannot be determined. In the remainder, the number ranges from 14 to 23. More than half of the specimens have no cirri, while the others have from 3 to 6 weak and insignificant ones. The colour is variable, but is usually light; in one case "dominantly grey with white stripes," in others "light brown," or again handsomely cross-banded, light and dark. Ten of the specimens are from St. XIV, 19 fms., two are from St. XVI, 20 fms., one is from St. XVII, 19 fms., and one from St. XXII, 13½ fms.

Comanthus samoana, A. H. Clark.

A. H. Clark, 1909, Proc. U.S. Nat. Mus. XXXVII, p. 30.

There is a single *Comanthus*, which is evidently of this species. It is about 150 mm. in diameter, dark olive-brown, with 21 arms and 14 short, rather stout cirri.

Zygometra microdiscus (Bell).

Antedon microdiscus, Bell, 1884, Rep. Zool. Coll. "Alert," p. 163, pl. xv.
Zygometra microdiscus, A. H. Clark, 1909, Zool. Anz. XXXIV, p. 367.

A small comatulid from St. XXIII, 8 fms., has perplexed me very much. It is in poor condition, with many arms and nearly all the cirri broken or missing. The arms are about 60 mm. long, with all division series 4 (3 + 4); III Br. series present on one arm. The colour is deep reddish-purple. Mr. Austin H. Clark, the well-known authority on crinoids, thinks this individual may best be regarded as a "dwarf *Zygometra microdiscus*."

Zygometra punctata, A. H. Clark.

A. H. Clark, 1912, Proc. Biol. Soc. Wash. XXV, p. 24.

There are three specimens of this interesting and somewhat puzzling species; one, with arms 75–80 mm. long, has a label, "G.B.R.E. Sept. 6, 1928, 11.30 a.m. North of island, about 9 fms. Rectangular dredge. Yellow with black markings. Bottom mud";

a second with 21 arms of about the same length has a label, "*Comanthus* sp. Low Id.," and is dull buff, spotted or, distally on the arms, banded with purple; the third, with only 11 arms, the single II Br. series 2, the cirri with about 20 segments, several of which are long, the colour "dark and pale brown" is from St. XVI, 20 fms., and is doubtfully referred to this species.

Heterometra crenulata (Carpenter).

Antedon crenulata, P. H. Carpenter, 1882, J. Linn. Soc. Zool. XVI, p. 507.
Heterometra crenulata, A. H. Clark, 1918, "Siboga" Exped., The Unstalked Crinoids, XLII*b*, p. (77), 78.

The single specimen of this species has arms about 80 mm. long and its label reads, "Crinoid. Greyish-brown. St. IV. Dredge. 70% alcohol."

Heterometra nematodon (Hartlaub).

Antedon nematodon, Hartlaub, 1890, Nachr. Ges. wiss. Göttingen, Mai, p. 185.
Heterometra nematodon, A. H. Clark, 1911, Mem. Aust. Mus. IV, 15, p. 768.

A small comatulid, about 125 mm. across, with 37 arms and 18 cirri, having 40 segments, seems to be of this species. The colour is fawn, darker orally. The label reads: "St. XIII. 7 March 29. Dark brown with white patches. Dredge. Alcohol."

Amphimetra jacquinoti (J. Müller).

Comatula jacquinoti, J. Müller, 1846, Mber. K. Preuss. Akad. Wiss. p. 178.
Amphimetra jacquinoti, A. H. Clark, 1918, "Siboga" Exped., The Unstalked Crinoids, XLII*b*, p. 85.

There are four specimens of this species in the collection, two being taken at St. XII, one at St. XIII, and one "north of island, about 9 fms." The smallest has the arms slender and only 70–80 mm. long, there are but 27 or 28 segments in the cirri, and twelve in P_2; the colour is very pale reddish, almost white dorsally. This specimen answers well on the whole to the description of *A. pinniformis* (P. H. C.) and I am inclined to think that supposed species is really based on young specimens of *jacquinoti*. The other specimens are larger and stouter, with arms 100–125 mm. long. They are reddish-white dorsally, and more or less deep red orally; in one case the whole specimen is uniformly dull red, but it may have been stained in the alcohol. One specimen is said to have been "purple and yellow" in life; apparently the purple has become red, and the yellow whitish, as the result of preservation.

Lamprometra gyges (Bell).

Antedon gyges, Bell, 1884, Rep. Zool. Coll. "Alert," p. 160, pl. xii, figs. B, *a*, *b*.
Lamprometra gyges, A. H. Clark, 1913, Proc. Biol. Soc. Wash. XXVI, p. 144.

A single adult specimen, more or less broken, but in fair condition, with arms 60–75 mm. long, and of a deep red-purple colour, has the labels: "G.B.R.E. General Survey, 24/4/29, A4," and "*Dichrometra tenera* (Hartlaub), 1 spec. H. L. Clark, St. XVII."

This is apparently a specimen seen by me in Sydney in November, 1929, and given Hartlaub's name, which is a synonym of *gyges*. Obviously one of the labels is wrong as to locality, and I believe the specimen came from A4.

Oligometra carpenteri (Bell).

Antedon carpenteri, Bell, 1884, Rep. Zool. Coll. "Alert," p. 157, pl. x, figs. A, *a–c*.
Oligometra carpenteri, A. H. Clark, 1908, Proc. Biol. Soc. Wash. XXI, p. 126.

This characteristic species of northern Australia is represented in the collection by a single small adult, light brown, arms faintly banded (distally) or striped (proximally), from St. XIV, 19 fms.

Iconometra anisa (H. L. Clark).

Oligometra anisa, H. L. Clark, 1915, Pap. Dept. Mar. Biol. Carn. Instn. VIII, p. 105.
Iconometra anisa, A. H. Clark, 1929, J. Linn. Soc. Zool., XXXVI, p. 643.

There are two small dark-coloured specimens of this species in the collection taken at St. XIX, 10 fms. As *anisa* was known previously only from the Murray Islands, it is interesting to record this slight extension of its range.

Colobometra perspinosa (Carpenter).

Antedon perspinosa, P. H. Carpenter, 1881, Notes Leyden Mus. III, p. 178.
Colobometra perspinosa, A. H. Clark, 1909, Proc. Biol. Soc. Wash. XXII, p. 6.

An interesting comatulid taken in "Penguin Channel, 16 fms. Mud. 21/12/28," in only fair condition, seems to be best referred to this species, but the 18 cirri have only 40–48 segments and the whole animal is less spiny than usual. It is thus nearer to the East Indian species *vepetrum*, but as I doubt whether *vepetrum* is valid, it seems best to call this specimen *perspinosa*, the species previously known from the east coast of Australia.

OPHIUROIDEA.

The collection of 162 brittle-stars is of very great interest, as it includes one species and one variety (*Ophiocoma delicata*, *Ophiarthrum elegans* var. *unicolor*) here described for the first time and three genera not hitherto known from Australia (*Ophiomitra*, *Ophiurodon*, *Cryptopelta*). There are also two species now recorded from Australia for the first time (*Ophiocnida echinata*, *Ophiomastix bispinosa*) and two others never before reported from Queensland (*Ophiomyxa australis*, *Amphioplus lobatus*). It is interesting to note that these two species are both from the south. About one-third of the 28 forms in the collection are therefore additions to the Queensland marine fauna, and this fact again emphasizes the great richness of that fauna, which is still imperfectly known. Eight of the forms are Ophiocomids and six are Ophiodermatids, so that half of the brittle-stars collected belong to those two families. Dredging in deep water at St. XV, 210 fms., yielded the genera *Ophiomitra* and *Ophiurodon* here recorded for the first time from Australia, but no other Ophiurans were taken there.

Ophiomyxa, australis, Lütken.

Lütken, 1869, K. Danske Selsk. Vidensk. Skr. (5), VIII, hft. 2, p. 99. [Reprinted, Additamenta ad Hist. Ophiuridarum, pt. 3, p. 99.]

This widely distributed brittle-star has not previously been found on the Australian coast north of New South Wales, nor was it found at Low Isles, so its occurrence at Sts. XIV, XVI and XVII in some numbers (26 specimens) is really quite remarkable. But as it is found in Fiji and is known also from Southern Japan, its occurrence near Lizard Island is not inexplicable.

Euryale asperum, Lamarck.

Lamarck, 1816, Anim. s. Vert. II, p. 538.

A single small specimen, only 13 mm. across the disk, represents this common species. It is dark reddish-brown in colour and was taken at St. XII, 10–15½ fms.

Ophiomitra dives, Koehler.

Koehler, 1922, Bull. U.S. Nat. Mus. C., V, p. 107, pl. x, figs. 1–4 ; pl. xciv, fig. 2.

A single brittle-star, 14 mm. across the disk, taken at St. XV, 210 fms., represents this species, hitherto known only from a single station in the Philippine Islands. The Australian specimen is smaller and lighter coloured than Koehler's types. It is dry and probably more or less bleached, but there is still a reddish tinge, and the dark longitudinal line on the upper surface of the arms is very evident. There are some trifling differences in the under arm-plates, but otherwise the resemblance to the Philippine specimens is striking.

Ophiurodon cupidum (Koehler).

Ophioconis cupida, Koehler, 1905, "Siboga" Exped., XLV*b*, Ophiures littorales, pt. 2, p. 15, pl. i, figs. 19, 20.
Ophiurodon cupida, Matsumoto, 1915, Proc. Acad. Nat. Sci. Philad., LXVII, p. 84.

A brittle-star, taken at St. XV, 210 fms., with all the arms broken off close to the badly damaged disk, which is 7 mm. across, is undoubtedly an *Ophiurodon*, a genus new to the Queensland coast, but it is impossible to say positively what the species is. In my opinion it is nearest to the East Indian species *cupidum*, and it may for the present rest under that name.

Amphioplus lobatus (Ljungman).

Amphipholis lobata, Ljungman, 1867, Öfvers. K. K. Vet.-Akad. Förh. XXIII, p. 315.
Amphioplus lobatus, H. L. Clark, 1915, Mem. Harv. Mus. Comp. Zoöl. XXV, p. 258.

This species was originally described from a specimen only 6 mm. across the disk taken by Kinberg on the coast of New South Wales, near Sydney. So far as I know it has not been met with since. In the present collection are two brittle-stars, clearly *Amphioplus*, taken at St. XXV, 20–25 fms., which correspond so well to Ljungman's brief Latin description that I do not feel warranted in separating them as a different species.

One has the disk 8 mm. across and the arms are about 60 mm. long; the other is slightly smaller and lacks the disk. In the characters of the oral shields, arm-spines, arm-plates, adoral plates and oral papillae, the smaller specimen corresponds very closely to Ljungman's description, but the larger one has the lower armplates more nearly square and the oral shields are much elongated, about twice as long as wide. In both specimens there are six arm-spines on the proximal part of the arm, but distal to the eighth–tenth joint there are but five; beginning about the thirty-fifth segment there are distally but four. The next to the lowest spine is the longest and stoutest, but the lowest is nearly, and sometimes quite, its equal; where there are six spines the four uppermost are more slender than the two lowest. The scaling of the disk dorsally is coarse but rather even, about 25–30 to a square millimetre; on the interbrachial areas below it is much finer. The infra-dental oral papilla is thick and not scale-like; of the other three, the middle one is largest and most scale-like. The radial shields are straight, with distal ends slightly thickened, but very little wider than the proximal, fully 2½ times as long as wide. Both specimens are nearly white in colour, but the disk is distinctly pearl grey.

Ophiocnida echinata (Ljungman).

Ophiophragmus echinatus, Ljungman, 1867, Öfvers. K. K. Vet.-Akad. Förh. XXIII, p. 316.
Ophiocnida echinata ?, Lyman, 1874, Bull. Mus. Comp. Zoöl. Harv. III, p. 230, pl. iv, figs. 22, 23.

A single small specimen (disk 4 mm. across, arms 50–60 mm. long) of this species was taken at St. XXV, 20–25 fms. The disk is pale grey and the arms are nearly white with about 15 cross-bands of dull light brown, irregularly placed, but usually well spaced. Compared with a specimen of about the same size from the Philippines, the banded arms give it a noticeably different appearance, but I do not think the difference is of any real significance. The species has not been taken previously south of the East Indies.

Ophiactis savignyi (Müller and Troschel).

Ophiolepis savignyi, Müller & Troschel, 1842, Syst. Asteriden, p. 95.
Ophiactis savignyi, Ljungman, 1867, Öfvers. K. K. Vet.-Akad. Förh. XXIII, p. 323.

Eleven specimens of this tropicopolitan species were taken at the following places: One 5-armed adult, with disk 6 mm. across and arms 20 mm. long, in 4 fms., ¼ mile south of Cape Kimberly; five young 6-armed ones, Gen. Survey, 6.iv.29, Mangrove Park, and one similar specimen, 24.iv.29, Mangrove Park; three young ones from St. X, 14–17 fms., 22.ii.29, and one from St. XXV, 20–25 fms.

Ophiothrix longipeda (Lamarck).

Ophiura longipeda, Lamarck, 1816, Anim. s. Vert. II, p. 544.
Ophiothrix longipeda, Müller & Troschel, 1842, Syst. Asteriden, p. 113.

This common but as yet ill-defined species was taken at the following places: Two at Low Isles; one at St. IX, 12–14 fms.; one at St. XII, 10–15½ fms.; one, young with disk only 6 mm. across, at St. XXIII, 8 fms.; and one, not typical, and referred to *longipeda* with some doubt, at St. XIX, 10 fms.

Ophiothrix martensi australis, H. L. Clark.

H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 111, pl. xv, fig. 4.

A single fine specimen, 12 mm. across the disk, was taken with the trawl at St. XVII, 19 fms.

Ophiothrix nereidina (Lamarck).

Ophiura nereidina, Lamarck, 1816, Anim. s. Vert. II, p. 544.
Ophiothrix nereidina, Müller and Troschel, 1842, Syt. Ast. p. 115.

This beautiful brittle-star was taken in some numbers near Lizard Island, but apparently was not found at Low Isles. There are five specimens, 6–9 mm. across the disk, from St. XIV, 19 fms.; five, 5–10 mm. across, from St. XVI, 20 fms.; and eight, 6–9 mm. across, from St. XVII, 19 fms.

Ophiothrix stelligera, Lyman.

Lyman, 1874, Bull. Mus. Comp. Zoöl. Harv. III, p. 237, pl. iii, figs. 15–20.

This species is represented by only four specimens, and one of these, taken at St. XXV, 20–25 fms.. is only 3 mm. across the disk and somewhat decalcified, so that its identity is not beyond question. A small adult, taken at St. XVI, 20 fms., is labelled "red ophiuroid from red sponge"; both colour and habitat are characteristic of *stelligera*. The other two specimens are large adults, 8 mm. across the disk; one, from St. XVII, 19 fms., is pale brown, the other, from "off North Anchorage, low tide, 9 fms., 17.x.28," is deep, dull blue-violet; in both specimens the longitudinal white stripe on the upper side of the arm, so characteristic of the species, is very evident.

Ophiothrix striolata, Grube.

Grube, 1868, Jber. Schles. ges. vaterl. Kult. XLV, p. 45.

A single specimen of this species, 5 mm. across the disk, but with arms over 50 mm. long, was taken at Linden Bank, Sts. II and III, 28 fms., 24.xi.28.

Ophionereis semoni (Döderlein).

Ophiotriton semoni, Döderlein, 1896, Denkschr. Med.-naturw. Ges. Jena, VIII, p. 288, pl. xv, figs. 8, 8*a*.
Ophionereis semoni, Koehler, 1905, "Siboga" Exped. XLV*b*, Ophiures littorales, pt. 2, p. 54.

A very small brittle-star, 3 mm. across the disk, from St. XXII, 13½ fms., extends the known range of this species on the Queensland coast a little to the south.

Ophiocoma brevipes, Peters, var. *variegata*, E. A. Smith.

Ophiocoma brevipes, Peters, 1851, Mber. K. Preuss. Akad. wiss. Berlin, p. 465.
Ophiocoma variegata, E. A. Smith, 1876, Ann. Mag. Nat. Hist. (4), XVIII, p. 39.
Ophiocoma brevipes, var. *variegata*, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 130.

There is a single *Ophiocoma* in the collection which represents this protean variety. It is a very fine example, 23 mm. across the disk, of forma *dentata*, Lütken, and was taken at Gen. Survey, A4, 24.iv.29.

Ophiocoma delicata, sp. nov.

(Plate I, figs. 1–3.)

Disk 9 mm. in diameter ; arms five, slender, somewhat flattened, about 60 mm. long and only $1\frac{1}{2}$ mm. wide basally. Disk distinctly pentagonal, very flat, closely covered both above and on the interbrachial areas below with a coat of very small granules, none of which are at all elongated or spiniform ; on the upper surface of the disk there are 100 or more granules to a square mm., but adorally they are larger, and near the oral shields there are, in a similar area, about 60–70. No indication of radial shields. Upper arm-plates distally triangular, but with a very rounded distal margin, much longer than wide, well separated from each other ; at the middle of the arm they are fully in contact, the proximal angle being more or less truncated ; basally they are a little wider (1·2 mm.) than long (1 mm.), nearly square, with distal corners rounded, in contact for their full proximal width. Oral shields triangular with angles rounded, about as wide as long (1·3 mm.) ; madreporite with proximal angle more rounded than in the other plates, but not essentially different. Adoral plates long and narrow, not meeting either proximally or distally, widest distal to middle. Oral papillae 5 or 6 on each side, the inner ones spiniform, the distal wider and flatter. Tooth-papillae few and small (1 or 2 to 4 or 5), not forming a well-defined cluster below the column of 5 (or possibly 6) narrow, blunt and rounded teeth. First under arm-plate small (about ·8 mm. wide) diamond-shape, wider than long, with proximal and distal angles rounded or truncate ; second much larger, a trifle longer than wide, rounded pentagonal, with distal margin convex and lateral margins slightly concave ; succeeding plates similar, but larger and relatively wider, about a millimetre each way, at first broadly in contact, but rapidly becoming much less so ; distally the plates become hexagonal, well separated from each other and very much longer than wide. Side arm-plates relatively rather large, especially distally ; each carries 4 basally (distally only 3) long, slender, acuminate arm-spines, of which the uppermost and lowest are more or less nearly equal, and are distinctly the longest, sometimes equalling two full arm-segments in length ; the spines are fragile, but not hollow, and are never stout or clavate. Tentacle-scales 2, thin and flat, the outermost distinctly the widest, and overlying the base of the lowest arm-spine. Colour (dried specimen) : Disk, pale brown with forty or more dark brown spots, rounded, oval, or elongated, each of which is margined with white ; interbrachial areas below, similar ; upper arm-plates and proximal half of side arm-plates rather dark purplish-brown, with distal margin and distal part of lateral margins of upper plates and distal half of side-plates nearly white ; distally the whole upper plate becomes white, and the arms are then cross-banded with equal areas of brown and white ; the basal and the distal under arm-plates are white, but all of the large ones beyond the small basal ones have only the marginal portions light, the central area being purple brown ; area about mouth nearly white, but each oral shield has two (in one case only one) large purplish-brown spots, irregularly placed ; arm-spines nearly white, but each one has a more or less evident (generally faint) longitudinal, narrow dusky line, or a series of minute spots, on its upper side.

The specimen upon which the above description is based was taken with the dredge at St. XVII, 19 fms. Owing to the granulation of the disk and the two tentacle-scales, I was at first inclined to call it a colour variety of *brevipes* var. *variegata*, but comparison with many specimens of that form satisfied me, it could not properly be so treated. It differs from all specimens of *brevipes* in the shape and proportion of disk and arms, in the character of the arm-plates and spines and in the way in which the outer tentacle scale overlies the base of the lowest arm-spine, unlike any known *Ophiocoma*. The very scanty development of tooth-papillae made me suspicious that this brittle-star might be an ophiodermatid rather than an ophiocomid, but all of its characters except those of teeth and tooth-papillae are so obviously those of an *Ophiocoma*, I think it must be referred to that genus. As it is much more slender and fragile than any other species of the genus, the name *delicata* seems appropriate.

I regard as a young individual of this species a small and rather badly damaged brittle-star, with the disk only 4·5 mm. across and all the arms broken. The appearance and coloration of the arms is like that of the distal part of the arms in the large specimen. The colour of disk and oral shields is also like that of the adult, but there are very few granules anywhere on the disk (which may be due to youth, as is the case in *Ophiocoma riisei*), and there are apparently no tooth-papillae (which may also be a youthful condition). This little specimen is too young to show even its family characters clearly, but I have no doubt it is a youthful specimen of *delicata*. It was taken at St. XIV, 19 fms.

Ophiocoma scolopendrina (Lamarck).

Ophiura scolopendrina, Lamarck, 1816, Anim. s. Vert. II, p. 544.
Ophiocoma scolopendrina, Müller and Troschel, 1842, Syst. Asteriden, p. 101.

There are sixteen specimens of this very common species from the following places: Three Isles, 6.v.29. Low Isles. The Middle Moat, 21 and 22.ii.29. Gen. Survey, C1, 8.iii.29. Gen. Survey, Low Isles. Gen. Survey, 20.iii.29. Three Isles, 5.v.29.

Ophiomastix annulosa (Lamarck).

Ophiura annulosa, Lamarck, 1816, Anim. s. Vert. II, p. 543.
Ophiomastix annulosa, Müller and Troschel, 1842, Syst. Ast. p. 107.

One specimen from the south-west reef of Mer, Murray Islands: two others are presumably from the same place. A fourth specimen is from "Ribbon Reef, seaward sloping zone. 4.vi.29." Apparently the species does not reach as far south as Low Isles.

Ophiomastix bispinosa, H. L. Clark.

H. L. Clark, 1917, Bull. Mus. Comp. Zoöl. Harv. LXI, p. 442, pl. ii, figs. 1, 2.

An *Ophiomastix*, 15 mm. across the disk, with arms about 90 mm. long, from St. XIV, 19 fms., apparently represents the adult of this species, hitherto known only from a single young individual, 5 mm. across the disk, taken at Makemo in the Paumotus. Its occurrence on the Australian coast is most interesting. The dull olive-brown colour (dry) with the distal portion of the arms banded (at intervals of 4–6 segments) with a dirty whitish, and many of the arm-spines faintly annulated, is very similar to that of the holotype. The single, almost circular tentacle-scale is a striking feature, while the form of the oral shields (widest distal to middle) and the shape of the upper and under arm-plates (on the distal part of the arms, of course) are suggestive of the original specimen. Proximally the arm-plates, both above and below, are wider than long and more or less in contact. The arm-spines are usually 3, but proximally there are often 4 (with the uppermost much the longest and heaviest, though it is scarcely claviform), and occasionally only 2; distally there are never 4, but frequently only 2. The disk covering shows a marked difference from that of the holotype, in that the spinules are very numerous and rather uniformly short and sharp; more numerous and smaller near the margins of the disk than at the centre. This difference between the Australian and Makemo specimens is probably due to the youthfulness of the latter.

Ophiarthrum elegans, Peters.

Peters, 1851, Mber. K.-Preuss. Akad. Wiss. p. 463.

There are eleven specimens of this common and very widespread brittle-star from the following places: Gen. Survey, between Anchorage Reefs and Tripneustes Spit, 11.iv.29. Gen. Survey, F9, 4.iv.29. Gen. Survey, B2. Gen. Survey, B3. There are also two remarkable specimens, one from St. XIV, 19 fms., and one from St. XVII, 19 fms., which I am strongly tempted to consider representatives of an undescribed species, but have decided to call simply *O. elegans* var. *unicolor*, var. nov. These specimens have the entire disk above and below uniformly brown; in the smaller specimen (disk 12 mm. across) the shade is dark, but in the larger (16 mm.) it is a light greyish brown. The arms, about 5 times the disk diameter, are somewhat indistinctly banded, because at intervals of from 2 to 5 segments the upper arm-plate (or two consecutive plates) and the adjoining parts of the side arm-plates are dull cream-colour. The arm-spines are noticeably long, slender, and more or less evidently flattened; the uppermost is often nearly or quite equal to three arm-segments. There are dusky spots and bands on the arm-spines and a sprinkling of very fine blackish dots on the upper surface of the arms as in typical *elegans*. Owing to the slender arm-spines and the colour, these specimens appear quite unlike *elegans*, but a specimen in the M.C.Z. from New Guinea resembles them in both these respects, and yet has the margin of the disk and markings on the interbrachial areas of the lower surface distinctly light as in the usual form. This specimen is such a connecting link between *elegans* and *unicolor* that I am compelled to regard the latter as merely a variety of the former.

Ophiarthrum pictum (Müller and Troschel).

Ophiocoma picta, Müller and Troschel, 1842, Syst. Asteriden, p. 102.
Ophiarthrum pictum, Lyman, 1874, Bull. Mus. Comp. Zoöl. Harv. III, p. 225, pl. vii, figs. 2–4.

This beautiful brittle-star seems to be common at Low Isles, as there are seven specimens from the following places: Gen. Survey, Mangrove Park, 6.xi.29; the Western Moat on *Hippopus*, 13.xi.28. There are also some arm-fragments from "The Fungia Moat, among dead colonies of branched *Porites*, 6.iv.29." A small specimen

14 mm. across the disk was dredged at St. XVI, 20 mm. Several specimens are very fine, one, 31 mm. across the disk, particularly so; this is the largest specimen of *pictum* I have yet seen, and in life was about 35 mm. across the disk, and had arms more than 200, probably more than 250 mm. long.

Ophiarachna incrassata (Lamarck).

Ophiura incrassata, Lamarck, 1816, Anim. s. Vert. II, p. 542.
Ophiarachna incrassata, Müller and Troschel, 1842, Syst. Asteriden, p. 104.

This magnificent species is represented by three specimens, 43–45 mm. across the disk, of which one is from Low Isles, and the other two have no labels.

Pectinura yoldii (Lütken).

Ophiopeza yoldii, Lütken, 1856, Vidensk. Medd. naturh. Foren. Kjöb. p. 9.
Pectinura yoldii, H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 119.

A single specimen, 17 mm. across the disk, from St. XXI, 10 fms., represents this species.

Ophiochasma stellatum (Ljungman).

Ophiarachna stellata, Ljungman, 1867, Öfvers. K. K. Vet.-Akad. Förh. XXIII, p. 305.
Ophiochasma stellata, H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 121.

Four specimens of this species were taken at Stations XXII, XXIII, XXIV, in 8–16½ fms.

Ophiarachnella gorgonia (Müller and Troschel).

Ophiarachna gorgonia, Müller and Troschel, 1842, Syst. Asteriden, p. 105.
Ophiarachnella gorgonia, H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 123.

There is a single specimen from Gen. Survey, the Thalamita Flat, 21.iv.29.

Ophiarachnella infernalis (Müller and Troschel).

Ophiarachna infernalis, Müller and Troschel, 1842, Syst. Asteriden, p. 105.
Ophiarachnella infernalis, H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 124.

There are 23 specimens of this common species in the collection, ranging in disk diameter from 4 to 12 mm. Only one was taken at Low Isles; Gen. Survey, the Thalamita Flat, 21.iv.29. The others are from Sts. XIV, XVI, XVII, XIX and XXIII, in 8–20 fms.

Cryptopelta granulifera, H. L. Clark.

H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 131.

There are two brittle-stars in the present collection which appear to be adults of this species, hitherto known only from the small holotype taken at Mauritius. The smaller individual has the disk 10 mm. across, the arms 45–50 mm. long, and 7 arm-spines at base of arm, but the number soon drops to 6, and beyond the middle of the arm there are only 5. The disk is very light (dirty cream-colour), the arms olive grey, banded with a dark shade covering 7 or 8 segments, and then a light shade for about 4 ; the base of the arms is of the light shade ; the lower surface is uniformly whitish, or about the mouth, yellowish. This specimen was taken at St. XVII, 19 fms. At St. XIV, 19 fms. the larger specimen (12–13 mm. across the disk, arms 60–65 mm. long) was collected. It has 8 arm-spines at very base of arms, then 7 and then, from middle of arm on, only 6 ; at tip of arm there are but 5. The disk is light reddish-brown ; arms greyer and less distinctly banded than in smaller specimen ; lower surface fawn-colour, darkest on disk. In both specimens the first upper arm-plate is much wider than long, not at all circular as in the younger holotype. The flattening of the arms is marked, especially distally. The skin of the disk in these dry specimens is much wrinkled, which would indicate that in life the disk is somewhat soft and swollen.

The discovery of *Cryptopelta* near Lizard Island adds a new genus to the fauna of Australia, and is hence of very great interest. Koehler has described (1922, Bull. U.S. Nat. Mus., C, vol. v, p. 350) a species of *Cryptopelta* from the Philippines, which he calls *tecta*, closely resembling *granulifera*, but differing in having the first four or five of the basal under arm-plates covered by the fine granulation of the lower surface of the animal. In the Australian specimens these plates are perfectly bare and free from granules, so that they are apparently the Mauritian rather than the Philippine species.

Ophiolepis superba, H. L. Clark.

Ophiura annulosa, Blainville, 1834, Man. d'Act. p. 244, pl. xxiv, figs. 1–4 (*non* Lamarck, 1816).
Ophiolepis superba, H. L. Clark, 1915, Spolia Zeylan. X, p. 89.

This handsome brittle-star is apparently common at the Low Isles, for there are ten specimens in the collection, with disks from 17 to 32 mm. across. They are labelled : Gen. Survey, the Thalamita Flat ; Gen. Survey, A4, 10.iv.29. The only one which calls for any comment is an individual 25 mm. across the disk, the arms ranging from 25 to 75 mm. The colours are very dull, more or less tinged with olive, and I am uncertain whether this is artificial or not. The scaling of the disk is smoother than in the other specimens and has a peculiar appearance, so that I am inclined to think the peculiar colouring may be natural and due to some unusual feature of the environment.

ECHINOIDEA.

The collection of sea-urchins contains 154 specimens, representing 28 species of 23 genera, which is a very fair proportion of the Echini known from Queensland. Two genera (*Micropyga*, *Pericosmus*) are added to the fauna of Australia, and three additional species (*Nudechinus multicolor*, *Laganum dyscritum*, *Metalia spatagus*) are new to the continent ; of these the *Laganum* is new to science. The genus *Gymnechinus*, represented by the species *epistichus*, is also now definitely added to the Australian fauna, for while this species was supposed when described to occur in Australian waters, it is now for the first time reported from a definite locality. Dredging in deep water at St. XV, 210 fms. yielded the most extraordinary specimens, both *Micropyga* and *Pericosmus* occurring there.

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Prionocidaris bispinosa (Lamarck).

Cidarites bispinosa, Lamarck, 1816, Anim. s. Vert. III, p. 57.
Prionocidaris bispinosa (Lamarck) var. *aruana*, Döderlein, 1911, Abh. Senckenb. Naturf. Ges. XXXIV, p. 240.

This cidarid, so common on the northern coasts of Australia, was taken at only three places; at St. XXII, 13½ fms., an adult specimen, 40 mm. in diameter, the biggest spines less than 60 mm. long, and a young one, about half as large, were dredged; at St. XIV, 19 fms., a young one only 9 mm. in diameter was taken; and "north-east of Low Isles, about 8 fms., mud bottom, with stones, Sept. 1928," a young one, 20 mm. in diameter, with spines 35 mm. long was collected. None of these specimens calls for any special comment.

Prionocidaris verticillata (Lamarck).

Cidarites verticillata, Lamarck, 1816, Anim. s. Vert. III, p. 56.
Prionocidaris verticillata, Döderlein, 1911, Abh. Senckenb. Naturf. Ges. XXXIV, p. 243.

A particularly fine specimen of this striking sea-urchin was taken on the Low Isles reef, 6.vi.29; it is 30 mm. in diameter and the longest primaries are 27 mm. long, each with 3 of the characteristic whorls. The colour is less green than usual, but the oral primaries and the tips of the aboral ones are evidently greenish; shafts of upper primaries between whorls, rose-reddish; secondaries light, greenish-yellow with a dusky greenish blotch near tip and with a distinctly reddish or orange cast, especially at tip.

I cannot follow Mortensen in putting this species in a genus by itself, nor can I admit that if this were done, the name *Plococidaris* might be used; that name is an unquestionable synonym of *Prionocidaris*.

Centrechinus savignyi (Michelin).

Diadema savignyi, Michelin, 1845, Mag. Zool. (2), VII, p. 15.
Centrechinus savignyi, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, pp. v and 145, pl. xvii, figs 1, 2.

Four very young specimens of *Centrechinus*, 6–20 mm. in diameter, taken in the "General Survey, Low Isles," are to be referred to this species, as they show no white anywhere, and the very light-coloured spines are banded with purplish-red, much brighter than the brown of *setosus*. The smallest specimen bears the additional label "A4 24.iv.29."

Centrechinus setosus (Leske).

Echinometra setosa, Leske, 1778, Addit. ad Klein nat. disposit. Echin. p. 36.
Centrechinus setosus, Jackson, 1912, Mem. Boston Soc. Nat. Hist. vii, p. 28 (*partim*). H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, pp. v and 146, pl. xvii, figs. 3, 4.

This species also occurs at the Low Isles, but there is only a single specimen in the present collection. It is 18 mm. in diameter, with spines 36 mm. long; the latter are handsomely banded with wood-brown and white.

Echinothrix calamaris (Pallas).

Echinus calamaris, Pallas, 1774, Spic. Zool. I, fasc. 10, p. 31, pl. ii, figs. 4–7.
Echinothrix calamaris, Peters, 1853, Mber. K. Preuss. Akad. p. 484.

There are two adult specimens, one from Low Isles, and the other from "Outer Barrier, Yonge Reef, Inner Moat, 5.vi.29." Both have the interambulacral primaries fragile, hollow, black and white banded as is normal for *calamaris*, but the Low Isles specimen has the ambulacral primaries bright brown as in *E. diadema* and not the usual yellowish-green of *calamaris*.

Micropyga tuberculata, A. Agassiz.

A. Agassiz, 1879, Proc. Amer. Acad. Arts Sci. XIV, p. 200.

Dredging at St. XV, 210 fms., yielded a fine specimen of *Micropyga*, a genus new to Australia. It is 70 mm. in diameter, light reddish-purple (bright when wet) in colour, and has numerous club-shaped primary spines just below the ambitus. Comparison with cotypes of *tuberculata* from Cebu, P. I., shows it to belong to that species, but the tuberculation is surprisingly like that of *M. nigra*, as shown in the published figures of that species (H. L. Clark, 1925, Cat. Recent Ech. Brit. Mus., pl. iv). The question naturally rises whether the supposed differences in tuberculation between *nigra* and *tuberculata* have any validity; if not, is *nigra* entitled to any recognition as a species, or is it only a colour form?

Stomopneustes variolaris (Lamarck).

Echinus variolaris, Lamarck, 1816, Anim. s. Vert. III, p. 47.
Stomopneustes variolaris, Agassiz, 1841, Mon. d'Ech., Observ. Progrès Récens. Hist. Nat. Éch. p. 7.

Two specimens were taken at Low Isles; one is an adult, about 53 mm. in diameter, with short, stumpy primaries, the longest 30 mm. in length by 3 mm. in thickness, abruptly pointed, appearing as though they had been broken off and then the tip had regenerated; the other specimen, "Gen. Survey, 7.iii.29," is a young one, only 22 mm. in diameter.

Temnopleurus toreumaticus (Leske).

Cidaris toreumatica, Leske, 1778, Addit. ad Klein nat. disposit. Echin. p. 155, pt. x, figs. D, E.
Temnopleurus toreumaticus, Agassiz, 1841, Mon. d'Ech., Observ. Progrès Récens. Hist. Nat. Ech. p. 7.

At St. IX, 12–14 fms., a very fine specimen of this handsome urchin was taken. It is 32 mm. in diameter and the longest primaries are 23 mm. The test is very light olive, the primaries olive banded near tip with a lighter shade; many of the small primaries, especially orally, are banded their whole length; secondary and miliary spines very light, often nearly white, the larger ones faintly banded. The primary spines are notably slender and acuminate.

Salmacis belli, Döderlein.

Salmacis sphaeroides, var. *belli*, Döderlein, 1903, Denkschr. med.-naturw. Ges. Jena, VIII, p. 718.
Salmacis belli, Mortensen, 1904, K. Danske Vidensk. Selsk. Skr. (7), I, p. 68.

A good specimen of this lovely species was taken at St. XII, 10–15½ fms. It is 74 mm. h.d. by 43 mm. v.d. Most of the spines above the ambitus are broken or wanting, but orally and especially about the peristome they are still present. The test is a very light reddish-fawn colour, while the spines are green at base, becoming rose-red distally; at ambitus and below, the tips are crossed by one or two broad whitish bands; these are most marked on the oral primaries with their conspicuously wide and flattened tips, 1·5–2 mm. across.

Salmacis sphaeroides (Linnaeus).

Echinus sphaeroides Linnaeus, 1758, Syst. Nat. ed. X, p. 664.
Salmacis sphaeroides, Lovén, 1887, Bih. svensk. Vetensk. Akad. Handl. XIII, Afd. IV, No. 5, p. 69, pl. ii, figs. 1–3.

There are two specimens from St. XIX, 10 fms., one from Batt Reef, and one from Low Isles. The two latter and one from St. XIX are typical dark-coloured specimens, 60–80 mm. in diameter, but the second specimen from St. XIX, which is 75 mm. h.d. and 50 mm. v.d., has a peculiar appearance which may possibly be artificial. The test is pale grey violet, but this seems to be a superficial layer which rubs off easily, leaving the usual variegated light and dark green; spines almost white (a very pale reddish-lavender) banded, distally at least, with deep crimson.

Salmacis virgulata alexandri, Bell.

Salmacis virgulata, Agassiz and Desor, 1846, Ann. Sci. Nat. VI, p. 359.
Salmacis alexandri, Bell, 1884, Rep. Zool. Coll. "Alert," p. 118.
Salmacis virgulata alexandri, Döderlein, 1914, Michaelsen and Hartmeyer, Fauna Südwest-Austral. IV, p. 454.

At St. XIX, 10 fms., along with the preceding *Salmacis*, one typical specimen of this Australian subspecies was taken. It is 52 mm. h.d. by 35 mm. v.d.; the actinal spines are bright red violet, green at base, with sharply defined white tips; adapically the green becomes more and more dominant, until at the periproct the small spines are wholly green.

Temnotrema decorum, Döderlein.

Döderlein, 1914, Michaelsen and Hartmeyer, Fauna Südwest-Austral. IV, p. 459.

Although this lovely little urchin was not taken at the Low Isles, there are three specimens in the collection, two from St. XIX, 10 fms., and one from St. XXIII, 8 fms. They are all adult, ranging from 23 by 15 mm. to 26 by 18. They are light grey or greyish-olive, with the spines white or nearly so, many more or less green basally, each provided with one or two vermilion-red bands, which may be very distinct (orally) or very faint (adapically). This species has not previously been taken on the Queensland coast south of Torres Strait.

Tripneustes gratilla (Linnaeus).

Echinus gratilla, Linnaeus, 1758, Syst. Nat. ed. X, p. 664.
Tripneustes gratilla, Lovén, 1887, Bih. svensk. Vetensk. Akad. Handl. XIII, Afd. IV, No. 5, p. 77.

The single specimen of this common species is 93 mm. in diameter, with the test dark purple and the spines more or less nearly white.

Nudechinus darnleyensis (Tenison-Woods).

Echinus darnleyensis Tenison-Woods, 1878, Proc. Linn. Soc. N.S.W. II, p. 165.
Nudechinus darnleyensis H. L. Clark, 1912, Mem. Harv. Mus. Comp. Zoöl. XXXIV, p. 277.

A very small urchin, 4·5 mm. h.d., taken at St. XXI, 10 fms., seems to be undoubtedly the young of this species, which is known only from Northern Queensland. The primary spines are violet with white tips.

Nudechinus multicolor (Yoshiwara).

Echinus multicolor Yoshiwara, 1898, Ann. Zoöl. Jap. II, p. 60.
Nudechinus multicolor H. L. Clark, 1912, Mem. Harv. Mus. Comp. Zoöl. XXXIV, p. 276.

There are two small specimens of *Nudechinus* in the collection which are certainly not *darnleyensis*, but answer well to descriptions of *multicolor*, so that although they are too young for certain identification, I refer them with little hesitation to this Japanese species. The geographical problem involved is like that of *Temnotrema sculptum*, a species first described from Japan, but now known from Northern Australia also. Yoshiwara's type came from Akune, Satsuma Province, in Southern Japan, so the species is probably a warm-water form, with a considerable distribution in the East Indian region.

The smaller of the specimens before me is only 5 mm. in diameter, and was taken at Low Isles, " Gen. Survey, between Anchorage Reefs and Tripneustes Spit, 11.iv.29." The larger is 8 mm. h.d. by 4·5 mm. v.d., and comes from " Three Isles, Gen. Survey, May 5, 1929." In both specimens the test is variegated with white, light green and dark green, while the spines are ringed with 2 or 3 (rarely 4) narrow, not sharply defined, dusky bands ; in the smaller specimen these bands have a faint violet tinge, which in the larger is more definitely violet (or possibly reddish) in colour. In the larger specimen ocular I is insert, but ocular V is scarcely so ; the younger specimen has not been cleaned for observation, but apparently all oculars are exsert.

Gymnechinus epistichus, H. L. Clark.

H. L. Clark, 1912, Mem. Harv. Mus. Comp. Zoöl. XXXIV, p. 289, pl. xciii, figs. 22, 23 ; pl. cii, figs. 4, 5.

The taking of three specimens of this rare and little-known urchin, in the vicinity of Lizard Island, is most interesting, as it was hitherto known only from the types in the M.C.Z. Of these, the holotype is from the Philippine Islands, but the two paratypes are labelled Australia, and were apparently sent to A. Agassiz by Tenison-Woods as specimens of his *Echinus darnleyensis*, as they bear the label, in Mr. Agassiz's handwriting, " *Echinus darnleyanus*. Wood. Australia." Mortensen, long ago, suggested that Woods had confused more than one species under his new name, the types of which he recorded as from Cape Grenville and Darnley Island. The present specimens thus extend the known range of the species very considerably to the south.

At St. XVII, 19 fms., a very fine individual, 30 mm. h.d. by 15 mm. v.d., was taken, the largest specimen yet known. The abactinal system is similar to that of the type, except that the genital pores are drawn out distally as a deep furrow nearly or quite to the margin of the plate. The other two specimens, 22 × 11 mm. and 25 × 14, were taken at St. XIX. 10 fms.. and resemble the type-specimens in all essential particulars. All three of the specimens have the colours brighter than in the rather dingy types ; all large spines are light dull orange, fading to nearly white at base and at tip ; the orange is more or less tinged with purple, especially distally. where some spines are distinctly violet ; small spines and pedicellariae are white ; pedicels brown (dry) ; test light, but grey apically, with a strong violet tinge in the largest specimen ; apical system itself, greenish-white.

Echinostrephus molare (de Blainville).

Echinus molaris, de Blainville, 1825, Dict. Sci. Nat. XXXVII, p. 88.
Echinostrephus molare, A. Agassiz, 1872, Illust. Cat. Mus. Comp. Zoöl. Harv. VII ; Rev. Ech. pt. 1, p. 119.

There are four small typical specimens, about 15 mm. in diameter, and very dark coloured, taken "6.vi.29, Yonge Reef, outer moat. Boring Sticklie & *Diadema*." This species has not hitherto been taken on the Queensland coast south of Torres Strait.

Parasalenia gratiosa, A. Agassiz.

A. Agassiz, 1863, Bull. Mus. Comp. Zoöl. Harv. I, p. 22.

This is so interesting a sea-urchin that it is desirable to give details about each of the four specimens in the present collection. Three of them have only a label, which indicates that they were collected at Low Isles. The smallest is 16 mm. long, 11 mm. wide, and about 6 mm. high ; test black or very deep brown, spines dark olive-grey, with milled rings white, as usual ; oculars all exsert ; genitals all broadly in contact with periproct ; a single tubercle is present on the inner margin of each of genitals 1, 3 and 5 ; no other tubercles on abactinal system ; periproctal plates 4, the one touching genitals 2. 3 and 4 largest. A second specimen is a trifle larger and has the same colour, but the abactinal system is very different ; there are no tubercles present, except a very small one, on the inner margin of genital 4 ; ocular II is broadly insert, and genital 3 is completely shut off from contact with the periproct by genitals 2 and 4 being broadly in contact with each other ; the periproct has 4 normal plates as usual, very nearly equal in size. The largest specimen is 26 mm. long, 20 mm. wide, and 11 mm. high. In colour it is like the other two, but again we find a characteristic abactinal system ; all oculars are exsert, and all genitals are in contact with the periproct ; on the inner margin of each genital is a single rather large tubercle ; there are *six* periproctal plates, five are subequal, triangular. and form a symmetrical group around the anus ; the sixth plate is very small, pentagonal, and lies between genitals 2, 3 and 4, and two of the typical periproctal plates.

The fourth and most perplexing specimen was taken at St. XVII, 19 fms., and bears a striking superficial resemblance to a young *Echinometra*. It is 11·5 mm. long by 8·5 mm. wide. and nearly 5 mm. high ; the colour is reddish-grey, darkest on abactinal system, where the genital plates are definitely reddish ; spines pale reddish with white milled rings ; at ambitus and orally, the primaries (at least near their tip) are faintly or more or less distinctly (especially close to peristome) banded with dusky reddish ; oculars all fully exsert ; genitals all in contact with periproct ; no tubercles anywhere on abactinal system ; periproctal plates 7, of which 5 subequal ones form a circle in contact with genital plates, while 2 smaller ones lie side by side within that circle. This little specimen might well be referred to *Parasalenia pöhlii*, but I have lost faith in the validity of that species. The resemblance to a young *Echinometra mathaei* is also striking, as already said, for young Echinometras of this size have only 3 or 4 pairs of pore-pairs in an arc, and only a few plates on the periproct. The sum total of all the characters, however, leaves no doubt that this particular specimen is a *Parasalenia*.

Echinometra mathaei (de Blainville).

Echinus mathaei, de Blainville, 1825, Dict. Sci. Nat. XXXVII, p. 94.
Echinometra mathaei, de Blainville, 1830, Dict. Sci. Nat. LX, p. 206.

Of this widely distributed and very common sea-urchin there are ten specimens, ranging from about 25 to nearly 50 mm. in length. Several are of the common reddish colour, but the majority are the more conspicuous grey, greenish or violet forms with the primary spines white-tipped. The following localities are represented : Gen. Survey ; Gen. Survey, the Middle Moat, etc. ; Gen. Survey, Western Moat ; Yonge Reef, outer moat ; the Mangrove Park ; F9.

Laganum depressum, Agassiz.

Agassiz, 1841, Mon. d'Éch. : Monogr. des Scutelles, p. 110, pl. xxiii, figs. 1–7.

There are ten specimens of this common species, of which two are dead tests, with worm-tubes on them, from between Anchorage Reefs and Mangrove Park, 10.iv.29. Of the others, the largest are two tests, 60 × 50, and 67 × 55 mm. ; they are bare, pale yellowish, with thick margins, especially anteriorly. Three much smaller specimens, 32–45 mm. long, light grey-brown with a yellow-green cast, were taken at St. XXIV, 16½ fms. Dredging at Linden Bank, 28 fms., Sts. II and III, 24.xi.28, yielded three very young specimens, 18–23 mm. long, of a light silvery grey-brown colour.

Laganum dyscritum,* sp. nov.

(Plate I, figs. 5–9.)

Test distinctly pentagonal, rather thick, especially around margin, very slightly elevated at centre, but distinctly depressed proximal to margin, in the area occupied by the distal part of the petals ; length, 40 mm. ; greatest breadth, 38 mm., across the anterior pair of petals ; about 6·5 mm. high at centre ; 5 mm. thick at margin ; petaloid area, 27 mm. long by 26 mm. wide. Genital pores 5. Petals rather wide, with convex sides and blunt ends which are not closed. Peristome just a trifle anterior to centre of lower surface. Periproct small, about 2½ mm. long by rather more than 3 mm. wide ; its centre is 5 mm. from the posterior end of the test. Spines numerous and long, those on the oral surface, nearly or quite 2 mm. ; owing to the slenderness of the spines and their

* δύσκριτος = hard to determine.

great number, the covering of the test is remarkably like fur. Colour brown with a purplish tinge dorsally, duller and more grey orally; the spines singly are nearly white, with a faint reddish tinge.

The specimen from which the above description is taken (the holotype) is the largest of nineteen specimens from Low Isles. There are fifteen additional specimens from "off west of Low Isles, mud and gravel, 15.xi.28," ten more from "Agassiz trawling off north anchorage, Low Isles, 9 fms., 17.x.28," and a single specimen from St. IX, 12–14 fms. This last-mentioned specimen and one of those from Low Isles have a noticeable yellow-green cast to their dull brownish colouring, but they are not otherwise peculiar.

This species is closely allied to *depressum*, and I was at first inclined to consider these specimens merely a form of that species, but careful study and comparison with typical examples of *depressum* from various localities has satisfied me that it is better to recognize this Low Isles *Laganum* under a distinct name. As young specimens, and adult individuals retaining youthful characters (*i. e.* arrested variants, to adopt Jackson's very useful terminology), will probably be hard to distinguish from *depressum*, I have selected a specific name indicating that probability. Typical adult specimens of the two species are easily distinguished by several characters. Adult specimens of *depressum* have the width of the test ·80–·85 of the length, and the distance of the periproct from the margin is about ·20 of the test length; in *dyscritum* the width of the test is ·90–·95 of the length, and the distance of the periproct from the margin is about ·12 of the test length. In *depressum* the margin of the test is often not swollen and relatively is always less so that in *dyscritum*. The petals are smaller, and the petaloid area is noticeably less extensive in *depressum*. When the specimens are well preserved (and presumably, when living), *dyscritum* has the spines so long, slender and numerous, its covering is very much softer and more like a coat of fur than is that of *depressum*. Finally, I have never seen specimens of *depressum* of the dull purplish-brown colour of typical *dyscritum*, but individuals of the new species approach *depressum* in this respect.

Peronella orbicularis (Leske).

Echinodiscus orbicularis, Leske, 1778, Addit. ad Klein nat. disposit. Echin. p. 144, pl. xlv, figs. 6, 7.
Peronella orbicularis, A. Agassiz, 1872, Illust. Cat. Mus. Comp. Zoöl. VII, Rev. Ech. pt. 1, p. 149.

Four young specimens of a *Peronella* were taken at the following stations: XIV, 19 fms.; XXI, 10 fms.; XXII, 13½ fms.; XXV, 20–25 fms. These specimens range from 13 × 10 to 32 × 28 mm., and were all living when collected. They show some diversity of colour, ranging from reddish-brown to a dull yellowish-green. None of them are at all "orbicular," but they are not otherwise peculiar.

Pericosmus macronesius, Koehler.

(Plate I, fig. 4.)

Koehler, 1914, Ech. Indian Mus. VIII, 1, Spatangides, p. 133, pl. xii, figs. 1–5.

The addition of this notable genus to the fauna of Australia is of exceptional interest because of its rarity, and our very imperfect knowledge of its distribution and relationships.

A single specimen was taken at St. XV, 210 fms. It is in perfect condition and answers admirably to Koehler's detailed description. It resembles his two specimens in size and proportions, measuring 61 mm. in length, 57 in width and 37 in height; the apex is 27 mm. from the anterior edge of the test, and the anterior margin of the peristome is only 10 mm. from the same point; the posterior pair of petals are 17 mm. long and the anterior pair are 22 mm.; all are 4 mm. wide; the peristome is 10 mm. wide by 5 mm. long, while the periproct is 9 mm. wide by 7 mm. high. The colour is a bright purple, but the individual spines which clothe the test quite thickly are a pale lavender when one is looked at by itself.

As Koehler's specimens lacked spines and pedicellariae, it is worthy of note that both are very abundant in the present individual. Dorsally the spines are very slender, slightly thickened at the tips, distinctly curved and more than 2 mm. long; orally they are longer and stouter and more pointed, many exceeding 5 mm. in length; at the posterior end of the test just below the marginal fasciole they form two tufts, neither conspicuous nor well-defined, yet sufficiently evident to warrant mention. The pedicellariae are found everywhere, but are particularly abundant orally. Ophicephalous pedicellariae with short wide valves, somewhat like those of *Brissopsis*, crowd the ventral ambulacra where they reach their largest size; the stalks are a millimetre long, while the valves are nearly half as much. All the rest of the pedicellariae seem to be rostrate or possibly tridentate; no sharp line can be drawn between the various forms, but the smallest are most nearly the tridentate type; the larger ones resemble the two forms figured by Koehler for *Faorina;* most of them have the valves long, very slender and strongly arched, ranging in length from less than half to more than a whole millimetre, commonly exceeding the stalk; the other form, much less common but by no means rare, has the valves much wider and stouter, especially at the tip, and about ·75–·90 mm. long. No globiferous pedicellariae were noted. On the whole the resemblance of the pedicellariae to those of *Faorina* is sufficient to warrant belief in the rather close relationship of the two genera. On the other hand, they are rather convincing proof that, as suggested when the species was first described, *Pericosmus abatoides*, H. L. Clark, is not properly congeneric with *P. macronesius*; it is probably related to *Abatus*, and will ultimately have to be made the type of a new genus.

Hypselaster fragilis (A. Agassiz and Clark).

Periaster fragilis, A. Agassiz and Clark, 1907, Bull. Mus. Comp. Zoöl. Harv. LI, p. 138.
Hypselaster fragilis, H. L. Clark, 1917, Mem. Mus. Comp. Zoöl. Harv. XLVI, p. 189, pl. cxlviii, figs. 5-8.

A small spatangoid, 22 mm. long, 18 mm. wide and 16 mm. high at the posterior apex, was dredged at St. XXI, 10 fms. It is dirty whitish with a markedly rose-reddish tinge and shows two (and only two) large genital pores. There seems to be no doubt that it is a young specimen of the species first taken by the "Challenger" in Torres Strait (unless Juke's specimen taken in 1846 at Cape York is really the same species), but first described by Agassiz and myself as *Periaster fragilis* from a young specimen taken at a depth of 391 fms. in Japanese waters. Finding the species near Lizard Island is therefore of very great interest.

Schizaster lacunosus (Linnaeus).

Echinus lacunosus, Linnaeus, 1758, Syst. Nat. ed. X, p. 665.
Schizaster lacunosus, Lovén, 1887, Bih. svensk. Vetensk. Akad. Handl. XIII, Afd. IV, No. 5, p. 168.

There are two small specimens dredged at St. XXIII, 8 fms., which call for no comment, except that they extend the known range of the species considerably to the southward.

Brissopsis luzonica (Gray).

Kleinia luzonica, Gray, 1851, Ann. Mag. Nat. Hist. (2) VII, p. 133.
Brissopsis luzonica, A. Agassiz, 1872, Illust. Cat. Mus. Comp. Zoöl. Harv. VII, Rev. Ech. pt. 1, p. 95.

A single small *Brissopsis*, 23 mm. long by 18 mm. wide, with a well-marked anal fasciole, was taken at St. VI, 114 fms., and is best referred to this widespread species, extending somewhat the southern limit of the known range.

Metalia spatagus (Linnaeus).

Echinus spatagus, Linnaeus, 1758, Syst. Nat. ed. X, p. 665.
Metalia spatagus, Lovén, 1887, Bih. svensk. Vetensk. Akad. Handl. XIII, Afd. IV, No. 5, p. 162.

Three specimens of this *Metalia* are of great interest because of their very large size, and the fact that the species has not hitherto been recorded from Australia. They have no locality labels but are supposed to be from Low Isles. The first two are about 102 mm. long, 86 mm. wide and 50 mm. high ; one is a perfectly bare and bleached test, the other is nearly bare and somewhat broken, but is not bleached. The third is the largest recorded specimen yet recorded, measuring 110 × 93 × 52 mm. ; it still has many spines present on the dorsal surface, and is not at all bleached.

Metalia sternalis (Lamarck).

Spatangus sternalis, Lamarck, 1816, Anim. s. Vert. III, p. 31.
Brissus sternalis, Gray, 1855, Cat. Recent Echinida, pt. 1, p. 51.

There are only two small specimens of this common species, already known from the Queensland coast. They are bare, bleached specimens labelled " *Brissus* sp., Low Id. Off Port Douglas, Queensland." They are 37 × 32½ mm. and 49½ × 46 mm., but even in the smaller, the confluence of the posterior petals has begun.

Maretia ovata (Leske).

Spatangus ovatus, Leske, 1778, Addit. ad Klein nat. disposit. Echin. p. 188, pl. xlix, figs. 12, 13.
Maretia ovata, Hamann, 1903, Bronn's Thierreich, II, abt. 3, p. 1397.

There are thirty specimens of this common spatangoid, ranging in size from 28 × 25 to 48 × 40 mm. Most of them are of the usual cream colour, with the petals, and often some conspicuous dorsal interradial blotches, dark brown, purplish or dusky ; a few specimens show little indication of the darker shades. They are from the following places :

Off north-east of Low Isles, about 8 fms., mud bottom with stones, Sept., 1928 ; off west of Low Isles, mud and gravel, 15.xi.28 ; Sts. VIII, 11 fms. ; XIX, 10 fms. ; XXV, 20–25 fms.

Lovenia elongata (Gray).

Spatangus elongatus, Gray, 1845, Eyre, Journ. Exped. Centr. Australia, I, p. 436, pl. vi, fig. 2.
Lovenia elongata, Gray, 1851, Ann. Mag. Nat. Hist. (2), VII, p. 131.

Three small specimens all from Low Isles represent this species, already well known from Australia. One is from " north-east of Low Isles, about 8 fms. mud bottom with stones," and one is from " west of Low Isles, mud and gravel " ; these two were taken with *Maretia*. The largest specimen, not yet half grown, is 40 × 30 mm. ; it is labelled " *Breynia australiae*. Low Id." Oddly enough the common and characteristic Australian spatangoid *Breynia* is not represented in the present collection.

HOLOTHURIOIDEA.

Although the collection of holothurians contains only 159 specimens, they represent no fewer than 43 species, of 14 genera. It is undoubtedly the most interesting and important of the four echinoderm groups which I have examined, as it includes not only two new species, but five species and one genus new to Australia and three other species new to Queensland. The new species (*Thyone perforata*, *Phyllophorus trapezus*) both belong to perplexing genera, but are, I believe, very well characterized. The genus and species new to Australia (*Mesothuria parva*) belongs to one of the deep-water groups that is not characteristic of any particular geographical area, and its occurrence therefore at St. XV is not unexpected. Of the other species new to Australia, three belong to the heterogeneous assemblage still included under *Holothuria* (*H. albiventer*, *fusco-olivacea* and *pleuripus*) and the fourth is a *Pentacta* (*P. jagorii*) of uncertain status. The three species new to Queensland (*Phyllophorus holothurioides*, *Pseudocucumis intercedens* *Pentacta coerulea*) have all been reported in recent years from the north-western coast of Australia. Of the 43 species in the collection, 26 were taken in the immediate vicinity of the Low Isles ; 9 species were taken at St. XVII and 9 at St. XIX, both of these places being near Lizard Island.

Opheodesoma sp. ?

There are two fragments of a synaptid from St. XVII, 19 fms., very dark grey in colour with big, white patches made up of spicules. These show that the specimen is an *Opheodesoma*, but as the head end is wanting, it would be unwise, if not impossible, to assign it to any particular species ; it is quite probably *grisea*.

Polyplectana kefersteinii (Selenka).

Synapta kefersteinii, Selenka, 1867, Z. wiss. Zool. XVII, p. 360, pl. xx, figs. 120–121.
Polyplectana kefersteinii, H. L. Clark, 1908, Smithson. Contr. Knowl. XXXV, Apodous Holothurians, pp. 16, 22, 77, pl. iv, figs. 20–22.

A couple of fragments without a head and in poor condition seem to represent this species. There is no locality label save " Probably from Low Isles."

Synapta maculata (Chamisso and Eysenhardt).

Holothuria maculata, Chamisso and Eysenhardt, 1821, Nov. Acta Leop. Carol. X, pt. 2, p. 352.
Synapta maculata, Jäger, 1833, De Holothuriis, p. 15.

There are two typical specimens of this well-known form, each with 15 tentacles; one, 425 mm. long and 30 mm. in diameter, is labelled simply "Low Isles"; the other, 900 mm. long, but only 15–20 mm. in diameter, is labelled "G.B.R.E.

Synaptula recta (Semper).

Synapta recta, Semper 1868, Reisen im Archipel. der Philippinen, I, Holothurien, p. 14.
Synaptula recta, H. L. Clark, 1908, Smithson. Contr. Knowl. XXXV, Apodous Holothurians, p. 84.

This species is represented by two specimens, neither of which is, however, typical. One is a light-coloured individual bearing the label "Mangrove Park, 17.iv.29," which has the calcareous particles and other features of *recta*, but possesses 15 equal tentacles; it is 70 mm. long and about 4 mm. in diameter; the tentacles are notably long, 7 mm., and the colour is uniformly pale brown; it seems better to consider this specimen a somewhat aberrant *recta*, than make it the type of a new species; I cannot consider it as either *reciprocans* or *rosea*, the only 15-tentacled species in the genus. The other specimen is about the same size, but of a darker colour, and is in two wretched fragments; there are apparently 12 tentacles, but it is hard to decide whether they are equal or not. This individual was dredged at St. XIII, 16½ fms.

Polycheira rufescens (Brandt).

Chirodota rufescens, Brandt, 1835, Rec. Actes Acad. Imp. Sci. St. Pétersb. p. 259. [Reprinted as Prodr. Descr. Anim. p. 59.]
Polycheira rufescens, H. L. Clark, 1908, Smithson. Contr. Knowl. XXXV, Apodous Holothurians, p. 120.

There are 15 specimens of this holothurian in the collection, but they call for little comment, except that the occurrence at Low Isles is a considerable southern extension of the known range. Most of these individuals are small, the largest measuring 95 mm. in length and 15 in diameter. They are of different shades of brown, and show great diversity in the number of wheel papillae. They were collected at the following places: Snapper Island, Gen. Survey, 7.iii.29; Gen. Survey, Inner Rampart, 20.iii.29; RD and R16, 22.iii.29; Tripneustes Spit, 21.iii.29.

Thyone papuensis, Théel.

Thyone fusus, var. *papuensis*, Théel, 1886, Voy. "Challenger," XIV, pt. 39, Holothurioidea, 2, p. 92, pl. viii, fig. 1.
Thyone papuensis, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 167.

There are three Thyones which I am referring to this species, but my study of them has led me to the conviction that the group of species related to *fusus*, as shown by the calcareous particles, is sadly in need of revision. The specimens at hand are as follows: St. XIX, 10 fms., a small individual, less than 20 mm. long, but 7 mm. in diameter, with very numerous pedicels ventrally, but dorsally with few pedicels, 15–20 of which are situated on wart-like elevations, which might be called papillae; these papillae form a series on each side of the dorsal surface, and tend to give the body a more or less quadrangular form. The calcareous ring and particles in the body-wall correspond well with Théel's description of what he found in *papuensis*. From "off north of east, Low Isles, 19.x.28, Agassiz trawling, 12 fms., mud," there is a specimen, about 60 mm. by 25, with tentacles well expanded but in poor condition, which shows no marked difference between the dorsal and ventral surfaces, though the pedicels are perhaps fewer and larger dorsally; the calcareous ring and particles answer almost perfectly to Théel's figures and description. The third specimen is, like the smallest, from St. XIX, 10 fms., but is very large, nearly 100 mm. long (not including the tentacles) and 25 mm. in diameter; the tentacles are notably big, the dorsal ones over 30 mm. long when fully extended; there is no marked difference between the dorsal and ventral surfaces and no indication that the body was ever quadrangular; the calcareous ring is very heavy and the posterior prolongations of the radial pieces are much shorter than in the smaller specimens, where they exceed the height of the ring itself. The calcareous particles in the body-wall are not distinguishable from those of the smaller specimens.

It seems to me, from the evidence of these three specimens, that Ludwig's *mirabilis* is identical with Théel's *papuensis*, and that both are very near *fusus*. But, as Dr. Deichmann called to my attention, the pedicels in the Australian species are noticeably larger than in the European and lack the curved supporting rod-tables so common in *fusus*. I think Semper's *villosus* from the Philippines may be identical with the Australian form, and several other forms described from the East Indian region also have tables more or less like those of *fusus*. Until I have examined more material I propose to let the Low Isles *Thyone* bear the name suggested by Théel, but it probably should be called *mirabilis* Ludwig, as that name is earlier than Théel's.

Thyone perforata,* sp. nov.

Length from mouth to anus along the somewhat concave back about 13 mm., but along the convex ventral side it is more than 20 mm.; diameter about 7 mm.; body nearly cylindrical at middle. Tentacles strongly contracted, apparently 9, with one smaller than the others; probably 10, with two small ones as usual in *Thyone*. Pedicels numerous all over the body, but distinctly less numerous on dorsal side. Anal teeth present, or, at least, anal papillae markedly calcified. Calcareous ring relatively large and stout; radial pieces 2 mm. high, of which about ·75 mm. consists of posterior prolongations; interradial pieces 1 mm. high, of which about one-third is the acute anterior point, and nearly 1 mm. wide; neither radial nor interradial pieces have the appearance of being made up of smaller pieces, as is so often the case in *Thyone*. Polian vessel single, rather conspicuous. Madreporic canal single, slender.

Calcareous particles, tables and perforated plates. Tables of two kinds, but both are characterized by large discs with many perforations, and a more or less complete spire; in one kind (Text-fig. 2), which I believe are youthful and would probably be lacking in adult specimens, the perforations are regularly arranged, four at the centre, then a circle of eight very large ones and then eight much smaller ones; this outer circle is usually incomplete and often wanting; in the mature tables (Text-fig. 3) the four central perforations are present, but smaller than in the youthful ones, while distal to them are many perforations of diverse sizes, but generally small, and quite irregularly arranged. In both sorts of tables the spire is commonly incomplete; it may consist merely of four vertical pointed rods, one arising from each of the bars which separate the four central perforations; these rods are, however, commonly united with each other by a single, median bar, forked at each end, giving a point of contact with each vertical rod; generally the vertical rods extend considerably above the connecting bar, and at the upper end send out two horizontal projections, at right angles to each other, growing out towards the corresponding projections of the neighbouring rods; these horizontal projections ultimately meet their fellows and fuse with them, forming a quadrilateral top to the spire; when complete this top carries several small and irregularly projecting teeth, usually at the corners. Very few tables have a complete spire, but probably in an adult individual the tables would be more generally complete. When fully developed, the height of the spire is rather more than half the diameter of the disc. The perforated plates (Text-fig. 1) are of diverse sizes and shapes, but are usually longer than wide; they may be constricted at the middle or they may be widest at that point. Neither terminal plates nor supporting rods have been detected in the pedicels, beyond question, but I believe terminal plates are present. The tables seem to be most abundant ventrally and scarce or wanting dorsally; the perforated plates, on the other hand, are scarce ventrally and more common, but by no means abundant dorsally; nowhere are the calcareous particles sufficiently common to overlap one another; they are usually well spaced in the body-wall, even ventrally.

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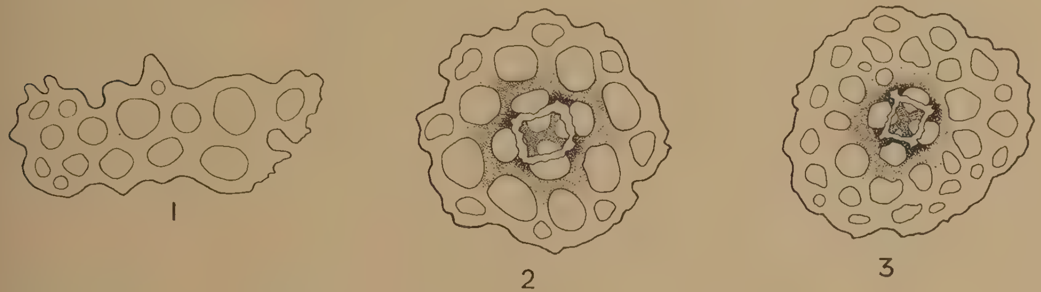
* The name is selected because of the large number of perforations in the disks of the tables.



Thyone perforata, sp. nov.

TEXT-FIG. 1.—Perforated plate from dorsal body-wall.
TEXT-FIG. 2.—Youthful table.
TEXT-FIG. 3.—Mature table. All figures × 445.

Colour of specimen light grey; tentacles dark brown. The unique holotype of this noteworthy species was taken at St. XII in "Penguin Channel, 10–15½ fms., rock and shell gravel, mud on edges of pit." So far as I can see this interesting *Thyone* is quite unlike any species as yet described, the characteristic tables setting it apart very distinctly from all the known species of the genus, and I do not think there can be any doubt that it is a *Thyone*.

Thyone sacellus (Selenka).

Stolus sacellus, Selenka, 1867, Z. wiss. Zool. XVII, p. 355, pl. xx, figs. 115, 116.
Thyone sacella, von Marenzeller, 1882, Verh. Zool.-Bot. Ges. Wien, XXXI, p. 134.

A specimen from St. X, 14–17 fms., seems to be of this species. It is 40 × 10 mm. and bright brown in colour. The pedicels are few, especially on the back.

Phyllophorus holothurioides, Ludwig.

Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 96.

Two small holothurians undoubtedly belong to this species, which has previously been reported from the East Indies and north-western Australia ; thus addition is made to the fauna of the Queensland coast. Like Ekman's specimen from north-western Australia, these individuals are very small, only about one-third as large as Ludwig's type. One is 25 × 13 mm., strongly contracted and dark grey in colour ; the pedicels are rather numerous and irregularly scattered, except at the ends of the body, where they are confined to a double series in each ambulacrum, most evident posteriorly ; the calcareous particles and ring are like Ekman's figures ; this specimen was dredged at St. XIX, 10 fms. The other individual, 25 × 9 mm., was taken at St. XVII, 19 fms., is of a light brown colour and the pedicels are apparently confined to the ambulacra ; the calcareous ring and particles are similar to those of the specimen from St. XIX ; the tentacles appear to be quite definitely arranged in an outer circle of five pairs of rather large tentacles and an inner circle of five pairs of much smaller tentacles alternating with them.

Phyllophorus trapezus,* sp. nov.

Length from tip of expanded tentacles to anus, along the concave dorsal side, 37 mm. ; along the convex ventral surface, 57 mm. ; diameter about 8 mm. ; body nearly cylindrical at middle, but tapering towards each end, especially posteriorly. Tentacles 20, fully expanded, 5 pairs of large ones (about 7 mm. long) alternating with 5 pairs of small ones (about 2 mm. long). Pedicels numerous all over the body, but both anteriorly and posteriorly they form a distinct double series in each ambulacrum, with none on the interambulacra between ; this is, however, for a distance of only 2–3 mm. ; at the middle of the body the terminal discs of the pedicels are about 0·4 mm. in diameter. Calcareous ring (Text-fig. 9) relatively high and stout (about 5 mm. high, with posterior prolongations of radial pieces about 7 mm. more) ; radial pieces square cut at anterior end, very deeply forked posteriorly, each posterior prolongation being made up of several pieces ; a deep longitudinal furrow on the outer surface nearly divides the anterior part of the plate into two narrow pieces ; interradial pieces long, narrow, very acute anteriorly, truncate posteriorly ; posterior half made up of 5–7 pieces. Polian vessel single of moderate size. Madreporic canal not detected.

Calcareous particles, tables, perforated plates and miliary granular plates. The granular plates (Text-fig. 8) are found only in the introvert, so far as known, and are not abundant there; they may be circular, oval or elliptical in form, but are noticeably convex, at least on the outer surface. The perforated plates (Text-fig. 7) are found only at the tips of the pedicels close to the terminal plates, which are large and circular. The tables are found well distributed over the body surface, but are nowhere abundant; the disk is circular (Text-fig. 5) or more or less quadrangular (Text-fig. 4), with the margin undulate or more or less rough, with projecting teeth, which are usually blunt or rounded at tip; there is a large perforation at centre, and around this is a circle of about 10 nearly circular perforations of considerable size (Text-fig. 6), usually with a number of smaller holes irregularly placed distal to them. The spire is about as tall as the diameter of the disk, is well developed, and crowned with a complete circular or square summit, open at the centre, and bearing a number of projecting blunt spines, as shown in Text-figs. 4 and 6.

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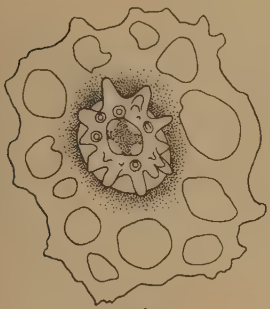
* This name is selected because of the characteristic tables in the skin.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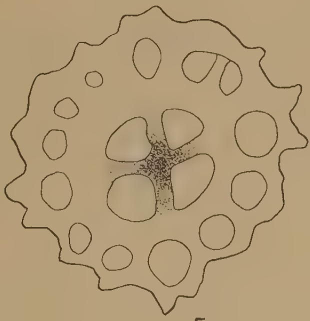
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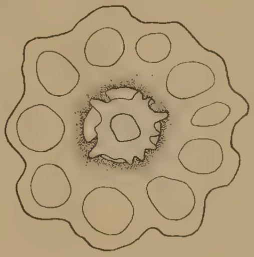
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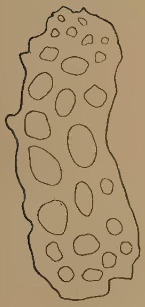
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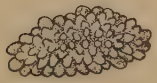
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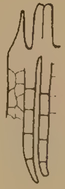
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Phyllophorus trapezus, sp. nov.

Text-fig. 4.—Table with base more or less quadrilateral, from holotype.
Text-fig. 5.—Table with more circular base, seen from below, from holotype.
Text-fig. 6.—Table from one of the paratypes.
Text-fig. 7.—Supporting plate from pedicel.
Text-fig. 8.—Miliary granule from introvert of holotype.
Text-fig. 9.—A piece of the calcareous ring, × 2.
Text-figs. 4–8 × c. 450.

Colour of holotype light yellowish brown, with tentacles a pale brown; one of the paratypes is a similar yellow brown, but the others are considerably darker, in part at least because they are much more contracted.

The holotype was taken at Low Isles. The 6 paratypes, of which the largest is 35 mm. long and 15 mm. in diameter, were dredged $\frac{1}{4}$ mile south of Cape Kimberley in 4 fms. on a bottom of shell and gravel, 2nd December, 1928.

The paratypes are all much contracted, but the calcareous particles are so similar to those of the holotype, I feel sure of their identity. In one of the smaller ones the tables are nearly all as shown in Text-fig. 6; I believe these are more youthful tables than the majority of those found in the holotype; in all of the specimens some of the tables are of the youthful type. There is no doubt that this species of *Phyllophorus* is nearly related to *cebuensis* (Semper) and *fragilis*, Ohshima, but it is easily distinguished from the former by the calcareous ring and from the latter by the tables. Unfortunately our knowledge of *cebuensis* is very incomplete, as no description of the calcareous particles has ever been published and Semper's single figure is very inadequate. Ohshima's description and figures of *fragilis* are very satisfactory, and the resemblance between *fragilis* and *trapezus* in general appearance and in the calcareous ring is striking, but the tables in the Japanese species have a low and usually incomplete spire, so I do not think the Australian specimens may be properly referred to it. Of course, abundance of material from the East Indian region may show sufficient diversity to prove that *cebuensis*, *fragilis* and *trapezus* are really but a single species.

Pseudocucumis africanus (Semper).

Cucumaria africana, Semper, 1868. Reisen im Archipel der Philippinen. I, Holothurien, p. 53. pl. xv, fig. 16.
Pseudocucumis africana, Ludwig, 1888, Zool. Jahrb. Syst. III, p. 815.

This little holothurian, easily recognized by its very characteristic calcareous plates, is represented in the present collection by three specimens, 30–35 mm. long, from Low Isles, labelled "*Holothuria* (*atra ?*)"; eleven specimens, 18–40 mm. long, from Low Isles, labelled "Only under coral blocks, juv."; one specimen, 18 mm. long, from Three Isles, 5th May, 1929.

Pseudocucumis intercedens, Lampert.

Lampert, 1885, Semper, Reisen im Archipel der Philippinen. IV, Abt. 3, Die Seewalzen, p. 254, fig. 54A.

The holotype of this species was from an unknown locality, but in 1886 Ludwig recorded a specimen from Amoy, China. It was not reported again until 1918, when Ekman discussed three individuals, one quite immature, from the north-western coast of Australia. It is therefore of much interest to find three specimens in the present collection; the largest, 36 mm. long, is a typical specimen from St. XVII, 19 fms.; a second, only 20 mm. long, much contracted, but typical, is from St. XVI 20 fms.; the third, from St. IX, 12–14 fms., although 30 mm. long, has a very thin body-wall with small tables, such as Ekman describes as found in a juvenal specimen examined by him. There is some ground for believing that *P. eurystichus*, H. L. C., from Friday Island, Torres Strait, is really identical with *intercedens*, but a re-examination of the holotype of that species leaves me in doubt. The Torres Strait specimen has more pedicels and wider ambulacra, and the calcareous ring is heavier and has distinct posterior prolongations on the radial pieces, though these are somewhat exaggerated in my original figure. These differences may prove to be due to age, but for the present the two species may be permitted to stand. There is no important difference in the calcareous particles, the tables being essentially alike in the two forms.

Actinocucumis typica, Ludwig.

Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 91.

At St. XIX, 10 fms., a very fine specimen of this species was taken. It is 125 mm. long by 20 mm. in diameter and bright brown in colour. The body-wall is notably firm, though not particularly thick.

Pentacta coerulea (Semper).

Colochirus coeruleus, Semper, 1868, Reisen im Archipel der Philippinen, I. Holothurien, p. 59, pl. xi, fig. 1; pl. xiii, fig. 18; pl. xiv, figs. 1, 14; pl. xv, fig. 1.
= *Colochirus quadrangularis*, auct. mult. since 1846.

For many years this holothurian has borne the name *quadrangularis* (Lesson), but Ekman (1918) has pointed out that Lesson's species was an aspidochirote and his name ought not to be used for a dendrochirote form. As I fully agree with this conclusion, I am adopting Semper's name, which is accompanied in its original publication with an adequate description and beautiful figures. Lesson's *Holothuria quadrangularis* is probably a *Stichopus*, and the figure and description would do fairly well for *chloronotus* (Brandt) except for colour. As the type locality is a bay on Waigeou, a place rarely visited by zoologist or collector, it is not impossible that *quadrangularis* is a valid species.

In the present collection are five specimens representing *Pentacta coerulea*: A small specimen, 65 × 22 mm., dredged at St. XII, 10–15½ fms., a very young one, only 19 × 6 mm., at St. XIV, 19 fms., and three very dark coloured individuals (the largest 110 × 35 mm.) at St. XIX, 10 fms. The species has not been recorded hitherto from the Queensland coast.

Pentacta cucumis (Semper).

Colochirus cucumis, Semper, 1868, Reisen im Archipel der Philippinen, I. Holothurien, p. 58, pl. xiii, fig. 17; pl. xiv, fig. 16.
Pentacta cucumis, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 171.

I am referring to this species a small holothurian, 25 × 11 mm. in its contracted condition, which was taken at St. XVI, 19 fms. It is probably young, but the calcareous particles warrant referring it to Semper's species. It must be said, however, that there is no genus of holothurians in which the species are more confused than in *Pentacta*, and one may not hope to be sure of the identity of any small specimens, until the group has been carefully revised.

Pentacta jagorii (Semper).

Colochirus jagorii, Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 60.

A small *Pentacta* from St. XVII, 19 fms., has been the source of much perplexity. Both Dr. Deichmann and I were inclined to regard it as a specimen of *P. australis*, Ludwig, which we do not consider a synonym of *doliolum*, Pallas. But the more critically it has been studied, the more difficult it has been to identify it with Ludwig's species, and I was about to set it down as an undescribed form, when my attention was directed to Semper's *Colochirus jagorii* from Singapore. The original description is very brief, and not accompanied by any figures; so far as I know, no further information regarding *jagorii* has been published, but Théel (1886) expressed the opinion that it may be identical with *quadrangularis*, Lesson. This does not seem to me probable.

The *Pentacta* before me, which I am referring to *jagorii*, agrees very well with Semper's description of that species, and it seems better to me to refer it to *jagorii* than to describe it as new. But a full description of the present specimen is here given so that in the future, when material from Singapore is available, it may be possible to determine whether the Australian form really is identical therewith. The individual from St. XVII is markedly quadrangular, becoming pentagonal anteriorly and rounded pentagonal at the posterior end. It is 42 mm. long, 8 mm. wide and 7 mm. high, 10 mm. from the anterior end, and 5 mm. wide and 4 mm. high close to the posterior end. Body-wall thick and hard, more or less rigid, from the abundance of calcareous plates and particles which it contains. Mouth terminal, not wholly closed by the five equal well-developed, triangular oral valves; these valves terminate the radii of course, and each bears 2 or 3 papillae (like those of the ambulacra, but smaller) and several small tubercles. Dorsal ambulacra each with a single series of 7 or 8 large, irregularly spaced papillae, about 2 mm. high by 1 in diameter; these papillae are truncate, and have a distinctly pedicel-like tip, with a terminal plate. Each lateral ambulacrum has a series of about a dozen similar papillae, somewhat smaller, more retractile and more like pedicels; this series is on the dorsal margin of the ambulacrum, and ventral to it are two or more crowded series of pedicels, which are fully retracted. Midventral ambulacrum with a double series of large pedicels, which are strongly retracted; it is uncertain whether there are additional pedicels on each side still more retracted; both anteriorly and posteriorly this ventral band of pedicels is replaced by large papillae like those of the dorsal radii, anteriorly there are two such, one in front of the other; posteriorly there are two, placed side by side. Besides the papillae and pedicels of the ambulacra, there seem to have been much smaller pedicels scattered all over the interambulacra; owing to the strongly contracted condition of the appendages, however, it is uncertain whether these are really indications of pedicels, or merely pits in the outer layer of the body-wall. Anus surrounded by overlapping scales, which are well developed, but are distinctly seen only when the animal is partly dried; they could hardly be called distinct "teeth."

Tentacles 10, the 2 ventral much smaller than the others, which are only moderately retractile owing to the large amount of calcareous material which they contain in the form of densely crowded perforated supporting rods. Calcareous ring simple and not peculiar; there are no posterior prolongations, but each piece is concave posteriorly and has a long anterior projection; the projections of the radial pieces to which the retractor muscles are attached are wider and blunter than those of the interradial pieces. There is a single rather large Polian vessel and two moderately developed clusters of genital tubes. Not more than a single stone canal is present.

Calcareous particles of the body-wall excessively numerous. The innermost layer is made up, as usual in *Pentacta*, of large, irregular, unequal plates or scales, many of which are a millimeter or more across. External to this is a thin but crowded layer of perforated plates and ellipses, no two of which are exactly alike; the fundamental form of these plates, which are rather delicate in structure, has four large perforations, ten or more marginal projections, and about ten small knobs on the outer (upper) surface; the number of perforations is generally more than four, and there is a tendency for projections and arches to grow up, meet and transform the plate into a perforated ellipse, which, however, is provided with numerous knobs and projections; on the other hand, many of the plates are more or less imperfectly developed. It is useless to give figures of these plates, so great is their diversity of detail; many of them are almost exactly like those found in *Pentacta minuta* and other species of the genus. Large, thick, knobbed buttons or plates, such as are characteristic of *australis* and *minuta*, seem to be quite lacking. The outermost layer of the body-wall is made up of somewhat compressed " baskets " or reticulate hemispheres, as deep as they are wide, with smooth outer surface and only a few rather coarse, marginal teeth. Supporting rods of pedicels in the form of narrow perforated plates; those of the tentacles, curved or bent rods, perforated at the ends and often at the middle also. Colour greyish white, with a brownish tinge on back and sides; terminal branches of tentacles dark brown.

A comparison of the above description with the brief diagnosis of *jagorii* given by Semper shows some points of difference which call for comment. Semper's specimen was considerably stouter, the dorsal papillae were bigger, and the pedicels in the ventral ambulacra much more numerous, but such differences might easily be due to age and degree of contraction. It is uncertain whether *jagorii* has the large papillae along the latero-ventral margins, but it may be inferred that they were present, since Semper calls especial attention to the presence of such papillae anteriorly and posteriorly on the ventral surface; it is quite unlikely these would be present if the lateral ones were absent. There is little significance in the absence of the " numerous, small " stone-canals on the circumoral water-ring to which Semper refers; this might be a matter of age or condition. Of course if such a difference were found to be constant, it would be of great interest and importance.

Pentacta minuta (Ludwig).

Colochirus minutus, Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 89.

Two small specimens of *Pentacta*, quite unlike in external appearance, but identical in their calcareous deposits, are best referred to this species, which is still very imperfectly known. The type locality is Bowen, Queensland. The smaller specimen is 28 mm. long, and 4 mm. in diameter; the form is distinctly quadrangular, but the body-wall is thin and not very rigid; the dorsal ambulacra bear a few fully retracted pedicels (or papillae ?) and are not clearly indicated; each of the three ventral ambulacra is marked by a double series of large pedicels; the ten tentacles are well expanded, the two ventral conspicuously smaller than the others; colour of both body and tentacles light brown.

This individual was dredged at St. XVI, 20 fms. The larger specimen was taken at St. IX, 12–14 fms., and has a very different appearance. The colour is nearly white, the tentacles are fully retracted, and the hard body is sharply quadrangular. The dorsal ambulacra bear small pedicels, many of which are on papillae of irregular size and appearance, each series forming a dorso-lateral angle of the body; the ventro-lateral angles are formed by a similar series, immediately below which is an imperfect double series of large pedicels; the midventral ambulacrum is indicated by a somewhat irregular series of large pedicels, double at each end, but at least four pedicels wide at the middle; many ventral pedicels are imperfectly or little contracted, owing apparently to the numerous calcareous rods and plates in the walls. This specimen is over 40 mm. long, 8 mm. wide and 7 mm. high.

In both specimens the calcareous particles correspond so well with the descriptions and figures given by Théel (1886) and Erwe (1913) that I do not see any differences worth noting. As in all Pentactas, there is the greatest diversity in the individual particles of any particular kind, but it would be futile to try to describe or figure all of these. It is still uncertain whether the differences between *minuta* and *australis* are really specific or whether they are merely a matter of age.

Pentacta tuberculosa (Quoy and Gaimard).

Holothuria tuberculosa, Quoy and Gaimard, 1833, Voy. "Astrolabe," IV, p. 131.
Pentacta tuberculosus, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 171.

Ten strongly contracted specimens, showing no indication of the living colour or form, represent this common species, which ranges from southern Japan to Port Jackson, N.S.W. None of these specimens is full grown and none call for comment; seven were taken at St. XIX, 10 fms., and one each at St. XIV, 19 fms., St. XVII, 19 fms., and in 12 fms., on muddy bottom, north of east of Low Isles, 16.x.28.

Mesothuria parva, Théel.

Mesothuria murrayi, var. *parva*, Théel, 1886, Voy. "Challenger," Zool. XIV, Holothurioidea, pt. 2, p. 186, pl. ix, fig. 2; pl. xvi, figs. 4, 5.
Mesothuria parva, Fisher, 1907, Proc. U.S. Nat. Mus. XXXII, p. 686, pl. lxxi, figs. 2A–C.

At St. XV, 210 fms., three specimens of this species were taken. They measure in their present condition 55 × 13 mm., 90 × 20 mm. and 150 × 30 mm. They are pale grey, with the tentacles darker. The bare ventral area is least evident in the smallest and most conspicuous in the largest specimen. The calcareous particles are similar in the three specimens, and agree well with Fisher's description and figures. He is, I believe, quite right in considering *parva* a species distinct from *murrayi*. The genus has not hitherto been recorded from Australian seas.

Holothuria albiventer, Semper.

Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 83, pl. xxx, fig. 14; pl. xxxv, fig. 5.

There are two strongly contrasted individuals from St. XVII, 19 fms., which seem to represent this East Indian species not hitherto known from Australia. They are each about 35 × 18 mm., and show no marked contrast in colour between the upper and lower surfaces. A third specimen, 55 × 20 mm., from St. XII, 10–15½ fms., is not quite so strongly contracted, and the ventral surface is conspicuously lighter than the dorsal. The calcareous particles, especially the tables, are somewhat different from those of the other specimens, but these differences do not seem to be significant.

Holothuria arenicola, Semper.

Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 81, pl. xx; pl. xxx, fig. 13; pl. xxxv, fig. 4.

This common and widespread species is represented by three specimens, of which two, from General Survey I, are strongly contracted, and yet are 180–190 mm. long by 20 mm. in diameter; they are strongly tinged with rust-colour—such a frequent characteristic of the species. The third specimen, labelled only Low Isles, is smaller (150 × 30 mm.) and not at all rusty, but the characteristic dark blotches of the dorsal side are well marked.

Holothuria atra, Jaeger.

Jaeger, 1833, De Holothuriis, p. 22.

This common species is represented by 8 specimens: 1 from Low Isles; 2 small ones also from Low Isles; 2 large ones (150 × 50 mm.), very black, "killed in fresh water, sand flats, covered with a sand film, 7.ix.28"; and 3 specimens, 80–150 mm. long, from "Low Island, off Port Douglas, Queensland."

Holothuria coluber, Semper.

Semper, 1868, Reisen im Archipel der Philippinen, I, Holothurien, p. 90, pl. xxviii; pl. xxx, fig. 28.

A single, average specimen is in the collection from "Gen. Survey 1M1."

Holothuria curiosa, Ludwig.

Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 110.

This species, originally described from Bowen, Queensland, is represented by a single small (75 × 17 mm.) but typical specimen from Low Isles. The general colour is brownish grey, but the periproctal area is very dark in striking contrast; dark rings at the base of the papillae are present, but are not conspicuous; they were a marked feature of Théel's specimen from Fiji, which was 180 mm. long.

Holothuria edulis, Lesson.

Lesson, 1830, Cent. Zool. p. 125.

There are two very typical specimens of this common species; the smaller, 150 mm. long by 25 mm. thick, dark slate grey above, light grey below, has no locality label; the larger (175 × 37 mm.), from Linden Bank, St. V, 29.xi.28, has the upper surface and the middle of the oral surface dusky, the remainder of the oral surface dirty cream colour. In life the species is quite handsome, the upper surface brown and the lower bright rose-colour, but alcohol completely destroys the beauty.

Holothuria erinaceus, Semper.

Semper, 1878, Reisen im Archipel der Philippinen. I, Holothurien, p. 91, pl. xxx, figs. 23, 24.

This species is represented by a single small specimen, 30 × 12 mm., from Gen. survey, 6d, 22.iii.29. It has been recorded from Port Mackay, Queensland.

Holothuria fusco-olivacea, Fisher.

Fisher, 1907, Proc. U.S. Nat. Mus. XXXII, p. 672, pl. lxix, figs. 3, 3*a–f*; pl. lxx, fig. 3.

Although this species has hitherto been known only from the Hawaiian Islands, I venture to refer to it a holothurian, 60 × 15 mm., from Low Isles. It answers so well to Fisher's description and figures, and the calcareous particles are so characteristic that I feel no doubt as to the identity. But there are no light rings around the dorsal papillae, so far as I can see, and I found none of the "very large tables," of which Fisher says they are "few." I am inclined to think it possible that these large tables do not really belong to this species, but came from a specimen of *Stichopus tropicalis*. Everyone who has worked with holothurian material knows how easy it is for spicules from one species to appear in preparations from a totally different form. Where any form of spicule is notably infrequent, suspicion as to its normal presence may well be aroused.

Holothuria hypamma, H. L. Clark.

H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 177, pl. xxxviii, figs. 20–24.

There is a single typical specimen, 50 mm. long, 20 mm. wide and 10 mm. thick, from Low Isles.

Holothuria impatiens (Forskål).

Fistularia impatiens Forskål, 1775, Descr. Anim. p. 121.
Holothuria impatiens Gmelin, 1788, Linn. Syst. Nat. ed. XIII, I, pt. 6, p. 3142.

There are sixteen specimens of this widespread, puzzling holothurian, which show such diversity of form and colour, it is hard to admit that they represent only a single species. They range from 35 to 200 mm. in length, with the large ones fully 30 mm. in diameter. The colour ranges from the uniform purplish-grey of "variety *concolor*" to a rich red brown. Several specimens have the papillae yellow in marked contrast to the purplish-grey body-wall. One small specimen is almost whitish with dark spots dorsally. As Fisher pointed out, the papillae have the tips quite like pedicels, with well-formed terminal plates. Several of the specimens have no label, and others are marked as from Low Isles only, but the following definite localities are given: Tripneustes Spit, 21.iii.29; extra collection E. A. F., RA. On the whole the calcareous particles of this species are quite distinctive and easily recognized. It seems to be true, however, that large specimens have the tables larger, with several or sometimes many small perforations peripheral to the usual nine holes in the disk, and the top of the spire crowded with numerous teeth. But I can find no satisfactory characters by which *botellus*, Selenka, as figured by Semper, can be separated from *impatiens*, even though I feel strongly inclined to doubt their identity.

Holothuria leucospilota (Brandt).

Stichopus (*Gymnochirota*) *leucospilota* Brandt, 1835, Rec. Actes Acad. Imp. Sci. St. Pétersb. p. 251. [Reprinted as Prodr. descr. Anim. p. 51.]
Holothuria leucospilota, Ludwig, 1881, Z. wiss. Zool. XXXV, p. 595.

There are nine small specimens, under 100 mm. long, from the following localities: Low Isles; Three Isles, 5.v.29; Three Isles, 8.iii.29. The species is so well known, these specimens call for no comment.

Holothuria marmorata (Jaeger).

Bohadschia marmorata, Jaeger, 1833, De Holothuriis, p. 18.
Holothuria marmorata, Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 79, pl. xxx, fig. 10; pl. xxxv, fig. 3.

There are two small, much-contracted specimens from Low Isles, one with the label 1M1.

Holothuria martensii, Semper.

Semper, 1868, Reisen im Archipel der Philippinen, I, Holothurien, p. 86, pl. xxx, fig. 16.

There are two fine examples of this notable species, taken in the vicinity of Lizard Island; one, 70 mm. long, 29 mm. wide and only 16 mm. high, was dredged at St. XXII, 13½ fms.; the other, 80 × 28 × 24 mm., was dredged at St. XXIII, 8 fms. In the smaller specimen the ventral papillae are very white. Study of this material satisfies me that *Holothuria subverta*, H. L. Clark, from the Murray Islands, is based on a specimen of this remarkable form.

Holothuria monacaria, Lesson.

Lesson, 1830, Cent. Zool. p. 225.

It is curious that this species, common at the Murray Islands and also found at Green Island near Cairns, should be represented in the present collection by only a single, poor, small specimen, labelled simply Low Isles.

Holothuria notabilis, Ludwig.

Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 102.

After much hesitation I have decided to refer to this species, originally described from Bowen, Queensland, two holothurians, one from 4 fms. ¼ mile south of Cape Kimberley, the other from Low Isles. The former is much contracted, about 50 mm. long by

17 mm. in diameter; the latter is in much better condition, about 80 × 20 mm. Both are deep brown above, lighter ventrally, with numerous whitish spots, in each of which is a pedicel; on the dorsal side is a double series of blackish blotches, which are rather faintly indicated, particularly in the larger specimen. The calcareous particles are quite distinctive and correspond fairly well with Ludwig's description (his figures are inadequate), but a large proportion of the buttons have more than three pairs of holes; Ludwig does not refer to the number of holes, merely saying the buttons are small. The tables range from perfectly-formed ones, with a disk having the margin spiny and a normal spire terminating in a nearly circular, ring-like top carrying a few teeth, to more or less aborted ones, the extreme form having no spire, being thus reduced to small concave plates with a few marginal spines and several irregular perforations, like Ludwig's figures. The calcareous ring is moderately stout, but the radial plates are not at all like Ludwig's figure, as they are wide, do not project posteriorly, and have that margin strongly concave. As already noted, the colour corresponds only imperfectly to Ludwig's description; he makes no mention of the numerous nearly whitish spots, which are so conspicuous in the present specimens. The internal organs of these specimens are in poor condition, but apparently Cuvier's organs were present. On the whole, it seems to me better to consider these individuals as *notabilis* rather than to describe them as a new species; the similarity in the calcareous particles is too marked.

Holothuria ocellata (Jaeger).

Bohadschia ocellata, Jaeger, 1833, De Holothuriis, p. 19.
Holothuria ocellata, Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 80.

A very fine typical specimen of this handsome species was dredged at St. XXI, 10 fms. It is 150 mm. long, 45 mm. wide and only 30 mm. high; the lateral margins are pronounced. In preparing my list of the echinoderms of Torres Strait (1921), this species was carelessly overlooked. It is closely related to *martensii*; the two should be separated generically from typical *Holothuria*. The description and figures given by Théel (1886) of the Challenger specimen from Torres Strait is what warrants referring the present specimen to Jaeger's species.

Holothuria pardalis, Selenka.

Selenka, 1867, Z. wiss. Zool. XVII, p. 336, pl. xix, fig. 85.

There are four specimens of this common species, but all are small and much contracted. One has no locality label, and one is labelled "Gen. Survey, RD and R16, 22.iii.1929." The other specimens are notable for the very numerous heaps of calcareous "buttons."

Holothuria pervicax, Selenka.

Selenka, 1867, Z. wiss. Zool. XVII, p. 327, pl. xviii, fig. 54.

The single specimen of this species is about 175 mm. long and was dredged at St. XIV, 19 fms. The colour is uniformly dark with no dorsal blotches, but the spicules, calcareous ring and internal anatomy are typical. There is a label reading : "Holothurian from which *Fierasfer* was obtained."

Holothuria pleuripus (Haacke).

Cystipus pleuripus, Haacke in Möbius, 1880, Beiträge zur Meeresf. der Insel Mauritius, p. 47.
Holothuria pleuripus, Ludwig, 1883, Ber. Oberhess. Ges. Nat-. u. Heilk. XXII, p. 174.

A little, flat holothurian, 16 mm. long, 9 mm. wide and only 4 mm. high, of a nearly white colour, was collected at Low Isles. There are large papillae dorsally, and numerous pedicels in approximately three series on the ventral side. The calcareous spicules are very characteristic, and seem to me more like those of this species than they are like those of *bowensis* Ludwig, the closely related species described from a single specimen, 45 mm. long, from Bowen, Queensland. It is possible that the two species will prove to be identical when more material is available.

Holothuria scabra, Jaeger.

Jaeger, 1833, De Holothuriis, p. 23.

There are four adult specimens, ranging in size from 170 × 90 mm. to 300 × 60 mm. All are of the usual finely speckled grey, and only one has large, dark blotches on the dorsal side. They were taken at Low Isles, and one is also labelled 1M1. I am also referring to this species two small, grey holothurians, only about 60 × 17 mm., whose calcareous deposits are in general like those of *scabra*. But a surprisingly large proportion of the buttons are asymmetrical and have 4-6 pairs of holes, while, as Théel says, in adults the buttons are mostly symmetrical, with three pairs of holes. Possibly in youth the character of the buttons is less fixed.

Stichopus chloronotus, Brandt.

Brandt, 1835, Rec. Actes Acad. Imp. Sci. St. Pétersb. p. 250. [Reprinted as Prodr. descr. Anim. p. 50.]

There are four specimens, ranging from 150 × 35 mm. to 240 × 45 mm. On two bright rust-brown specimens the dorsal and lateral papillae are very conspicuous. The other specimens (RP3) call for no comment.

Stichopus horrens, Selenka.

Selenka, 1867, Z. wiss. Zool. XVII, p. 316, pl. xviii, figs. 27–29.

There are five small adults (80–125 mm.), of which four were dredged at St. XIX, 10 fms., while one is labelled "South moat among dead branches of *Porites*." I am also referring to this species a little holothurian, about 10 mm. long by 6 mm. wide, translucent white, and with only 15 tentacles, but with calcareous particles which indicate it is a *Stichopus* and probably *horrens*. It is labelled "Gen. Survey, between Anchorage Reefs and Tripneustes Spit, 11.iv.29."

Stichopus variegatus, Semper.

Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 73, pl. xvi; pl. xxx, figs. 1, 6; pl. xxxv, fig. 1.

There are five specimens of this species, of which one very large one (300 × 100 mm.) is in poor condition, having been badly cut into. The smallest specimen measures 150 × 27 mm.

Actinopyga miliaris (Quoy and Gaimard).

Holothuria miliaris, Quoy and Gaimard, 1833, Voy. "Astrolabe," IV, p. 137.
Actinopyga miliaris, Bell, 1887, Sci. Trans. R. Dublin Soc. (2), III, p. 653, pl. xl, fig. 1.

This holothurian, commercially valuable as "black-fish," is represented in the present collection by two typical specimens, about 200 mm. long; one is from St. XVII, 19 fms. and the other is from St. XIX, 10 fms.

LIST OF STATIONS.

Particulars of reef-collecting stations are contained in "The Structure and Ecology of Low Isles and Other Reefs," by T. A. Stephenson, Anne Stephenson, G. Tandy and M. Spender, 'Great Barrier Reef Exped. 1928–1929, Sci. Reps.,' iii, 2, 112 pp., 27 pls., 1931. The dredging stations are as follows:

I. "Merinda." 24.xi.28. Linden Bank, 20 fathoms; coral bottom; dredge 30 minutes.
II, III. "Merinda." 24.xi.28. Linden Bank, 28 fathoms; shell and sand; dredge 10 minutes and 5 minutes.
IV. "Merinda" 24.xi.28. Linden Bank, 38 fathoms; mud; dredge 15 minutes.
V. "Merinda." 24.xi.28. Linden Bank, 37 fathoms; mud; Agassiz 30 minutes.
VI. "Merinda." 24.xi.28. Off Linden Bank, 114 fathoms; mud; dredge 15 minutes.
VII. "Merinda." 24.xi.28. Off Linden Bank, 114 fathoms; mud; Agassiz 15 minutes.
VIII. "Magneta." 21.ii.29. 1½ miles N.W. Low Isle, 11 fathoms; mud; 2 dredges, 30 minutes and 15 minutes; 1 Agassiz 30 minutes; 1 grab.
IX. "Magneta." 22.ii.29. Penguin Channel, 12–14 fathoms; in clean pit and on mud at sides; 6 dredges about 20 minutes each.
X. "Magneta." 22.ii.29. Across Satellite Reef, working on sides to S.W. and N.E., 14–17 fathoms; coral, shell, gravel and mud; 2 dredges, 20 minutes each.
XI. "Magneta." 23.ii.29. Inside Wentworth Reef, 7 fathoms; mud and rock; 5 dredges, about 15 minutes each.
XII. "Magneta." 24.ii.29. Penguin Channel, 10–15½ fathoms; rock and shell gravel, mud on edges of pit; 5 dredges, about 30 minutes each.
XIII. "Magneta." 7.iii.29. ½ mile W. of Two Isles, 16¼ fathoms; hard; 2 dredges, 20 minutes each.
XIV. "Magneta." 7.iii.29. ½ mile S.E. Lizard Island, 19 fathoms; shell gravel; 3 dredges, 20–30 minutes each. Rich Halimeda.
XV. "Magneta." 8.iii.29. ½ mile outside Cook's Passage, drifting N., 210 fathoms; clean sand and coral *débris*; 2 dredges, 30 and 45 minutes; 1 Agassiz, 30 minutes.

XVI. "Magneta." 9.iii.29. About $\frac{1}{2}$ mile W. of N. Direction Island, 20 fathoms; stony; 6 dredges, 20–30 minutes each.

XVII. "Magneta." 9.iii.29. About $\frac{1}{4}$ mile N. of N. Direction Island, 19 fathoms; sand, thick Halimeda; 2 dredges, 40 minutes each.

XVIII. "Magneta." 9.iii.29. $\frac{1}{2}$ mile S.E. Lizard Island, 20 fathoms; shell gravel, rich Halimeda; 1 Agassiz, 35 minutes.

XIX. "Magneta." 10.iii.29. About $\frac{1}{2}$ mile N. of Eagle Island, 10 fathoms; shell gravel, rich Halimeda; 3 dredges, 20–30 minutes.

XX. "Magneta." 10.iii.29. About $\frac{1}{4}$ mile N. Eagle Island, 6 fathoms; coral; 3 short dredges, quickly caught in coral.

XXI. "Magneta." 11.iii.29. $\frac{1}{2}$ mile N.W. Howick Island, 10 fathoms; mud and shell, forams; 2 dredges, 30 and 40 minutes.

XXII. "Magneta." 11.iii.29. To East of Snake Reef, 13$\frac{1}{2}$ fathoms; mud with forams. and shells; 2 dredges, $\frac{1}{2}$ hour each.

XXIII. "Magneta." 12.iii.29. In lee of Turtle Isles, 8 fathoms; mud and shell; 3 dredges, two 30 minutes, one 45 minutes.

XXIV. "Magneta." 13.iii.29. $\frac{3}{4}$ mile N.E. Pasco Reef, 16$\frac{1}{2}$ fathoms; hard and shell bottom; 6 dredges, all poor, as twine broke every time owing to great movement of boat.

XXV. "Magneta." 17.iii.29. In Papuan Pass, 20–25 fathoms; forams. and coral fragments; series of dredgings, 2$\frac{1}{4}$ hours in all.

XXVI. "Magneta." 18.iii.29. Papuan Pass, ? fathoms; dredge and 340 metre wire lost.

XXVII. "Magneta." 18.iii.29. Papuan Pass, 17 fathoms; coarse sand; series of dredgings, 1$\frac{1}{2}$ hours in all.

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DESCRIPTION OF PLATE I.

Ophiocoma delicata.

Fig. 1.—Aboral surface, natural size.
Fig. 2.—Aboral surface of disk and proximal arm-joints, × 3.
Fig. 3.—Oral surface of same, × 3.

Pericosmus macronesius.

Fig. 4.—Aboral surface, natural size.

Laganum dyscritum.

Fig. 5.—Paratype, aboral surface, natural size.
Fig. 6.—Paratype, oral surface, natural size.
Fig. 7.—Paratype, side view, natural size.
Fig. 8.—Holotype, aboral surface, natural size.
Fig. 9.—Holotype, oral surface, natural size.

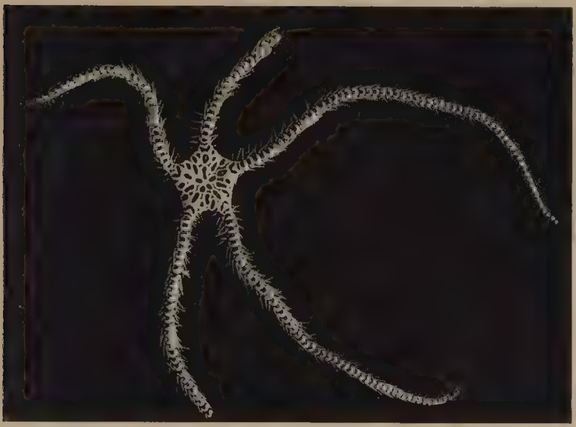
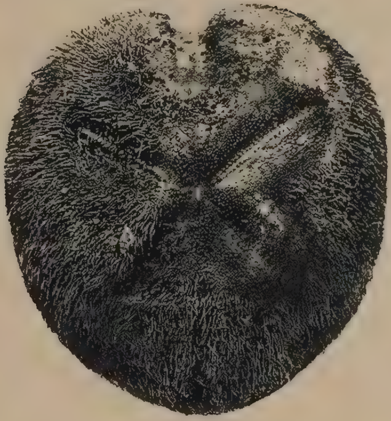


FIG. 1.



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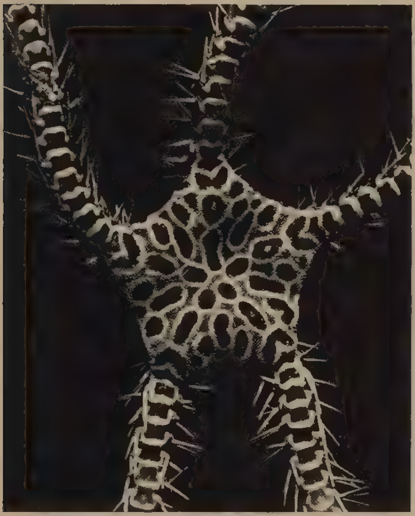
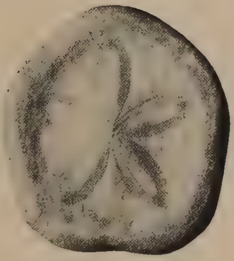


FIG. 2.



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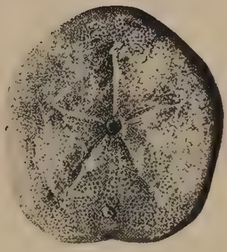

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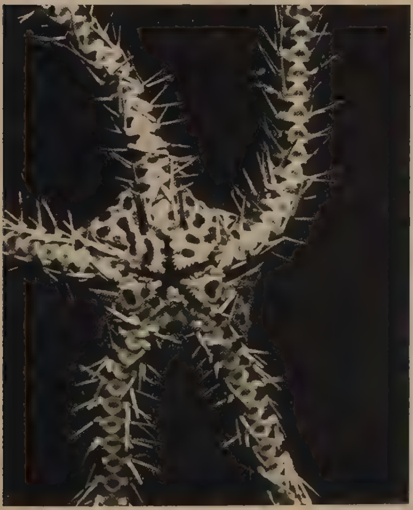

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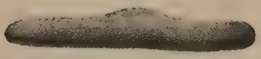

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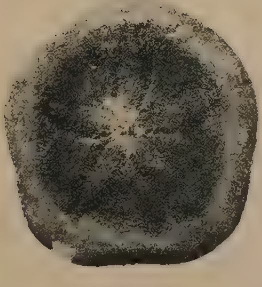

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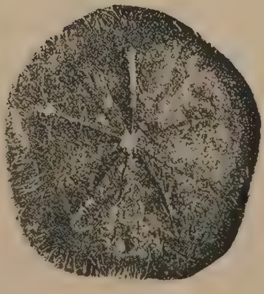

FIG. 9.

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INVESTIGATIONS

ASTEROIDEA

BY

ARTHUR A. LIVINGSTONE,
The Australian Museum, Sydney.

(With the permission of the Trustees of the Australian Museum, Sydney.)

WITH TWO TEXT-FIGURES AND TWELVE PLATES.

INTRODUCTION.

Many of the specimens were secured on reefs of dead and living coral which encircle Low Isles, and, as was to be expected, *Linckia laevigata* was by far the most abundant species during the period of my visit. The discovery of *Nardoa pauciforis* living in association with *Nardoa novaecaledoniae* was fortunate, as it confirms past records of their occurrence together and the fact that their coloration in life is practically identical.

The finding of *Culcita novaeguineae* considerably extends the known range of the genus.

By far the most interesting material was that obtained by dredging. These specimens add much to our knowledge of the Australian asteroid fauna.

A representative set of specimens will be deposited in the British Museum (Nat. Hist.); the remainder, including types, will be placed in the collection of the Australian Museum, Sydney.

I wish to thank Dr. C. M. Yonge, Leader of the Expedition, for the opportunity of studying this collection, and Mr. G. C. Clutton, of the Australian Museum, for the care and skill he has exercised in the preparation of most of the photographs here reproduced.

Through the kindness of Mr. C. C. A. Monro, of the British Museum, I have been able to examine and incorporate in this work photographs of type and other material in the British Museum. I wish to record my gratitude for his kind assistance.

Although this is essentially a report upon the Asteroidea collected by the expedition, it has been found necessary in some cases to refer to specimens in other collections, so as to understand fully the material before me.

The species referred to in the report are as follows. Those marked with an asterisk were not collected by the expedition :

Astropecten polyacanthus, M. and Tr.
Astropecten granulatus, M. and Tr.
Astropecten zebra, Sladen.
Luidia forficifera, Sladen.
Archaster typicus, M. and Tr.
Tosia queenslandensis, sp. nov.
Stellaster incei, Gray.
**Stellaster equestris*, Retzius.
**Stellaster princeps*, Sladen.
Anthenea tuberculosa, Gray.
Oreaster australis, Lütken.
Oreaster nodosus (Linnaeus).
**Oreaster alveolatus*, Perrier.
Culcita novaeguineae, M. and Tr.
Asterope carinifera (Lamarck).
Fromia milleporella (Lamarck).
Nardoa pauciforis (v. Martens).
Nardoa novaecaledoniae (Perrier).
Nardoa rosea, H. L. Clark.
Linckia guildingii, Gray.
Linckia laevigata (Linnaeus).
Ophidiaster propinquus, sp. nov.
Tamaria fusca, Gray.
Tamaria megaloplax (Bell).
**Tamaria hirsuta* (Koehler).
**Tamaria ornata* (Koehler).
**Tamaria* sp.
Nepanthia (? *brevis*) (Perrier).
Patiriella exigua (Lamarck).
Echinaster luzonicus (Gray).
Metrodira subulata, Gray.
Acanthaster planci (Linnaeus).
Retaster insignis, Sladen.

SYSTEMATIC ACCOUNT.

Astropecten polyacanthus, Müller and Troschel.

Astropecten polyacanthus, Müller and Troschel, Syst. der Asteriden, 1842, p. 69, pl. v, fig. 3; Fisher, Bull. U.S. Nat. Mus. 100, III, 1919, p. 63; H. L. Clark, Rec. Aust. Mus. XV, 1926, p. 184.

Localities.—Dredged N.E. Low Isles, 8 fathoms, mud and stones, September, 1928 (1). Station XXIV. 13.iii.1929. Three-quarters of a mile N.E. Pasco Reef, 16½ fathoms, hard shell bottom (1).

Distribution.—Red Sea to Zanzibar and Mozambique; Seychelles; Ceylon; Mergui; Andaman Islands; China; Japan; Philippines; Port Jackson, N.S.W.; Queensland; Admiralty Islands; Aru Islands; Fiji Islands; Hawaiian Islands.

Two specimens: R. = 72 mm., and 55 mm. The smaller specimen is badly distorted, and its R. measurement is only approximate.

Astropecten granulatus, Müller and Troschel.

(Plate VIII, figs. 2 and 3.)

Astropecten granulatus, Müller and Troschel, Syst. der Asteriden, 1842, p. 75; Döderlein, Denkschr. med.-naturw. Ges. Jena, VIII, 1896, p. 305, pl. xviii, figs. 30–30*a*; H. L. Clark, "The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 26.

Locality.—Low Isles, off N. Anchorage, 9 fathoms, low tide, 17.x.1928 (Agassiz trawl) (1).

Distribution.—Arafura Sea; Torres Strait; Queensland; Aru Islands; Philippines; Natal.

The single specimen has R. = 38 mm.

Astropecten zebra, Sladen.

Astropecten zebra, Sladen, J. Linn. Soc. Zool. XVII, 1883, p. 261; Sladen, "Challenger" Zool. XXX, 1889, p. 212, pl. xxxvi, figs. 3, 4; pl. xxxix, figs. 7–9; H. L. Clark, "The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 27 (and synonymy).

Locality.—Dredged quarter-mile S. of Cape Kimberley, 2.xii.1928, 4 fathoms, shell and gravel (2).

Distribution.—" The range of *zebra* appears to be from the Murray Islands westward through Torres Strait and northward to the Mergui Archipelago and the coast of Madras," H. L. Clark (*loc. cit.*). Queensland.

Two specimens: R. = 32 mm., 29 mm.

Luidia forficifera, Sladen.

Luidia forficifer, Sladen, " Challenger " Zool. XXX, 1889, p. 258, pl. xliv, figs. 5, 6; pl. xlv, figs. 5, 6; Döderlein, " Siboga " Exped., Mon. XLVI*b*, 1920, pp. 243, 278, figs. 28, 29 and fig. 3 in text (and synonymy); H. L. Clark, " The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 28.

Locality.—Station 12. 24.ii.1929. Penguin Channel, 10–15½ fathoms, rock and shell gravel, mud on edges of pit (2).

Distribution.—See Döderlein (*loc. cit.*, p. 243).

Two representatives of the genus *Luidia* (R. = 26 mm. and 21·5 mm.—both measurements from specimens in a slightly curled condition) are before me. After careful comparison with Sladen's description and figures they are considered referable to the above species.

Archaster typicus, Müller and Troschel.

Archaster typicus, Müller and Troschel, Mber. k. preuss. Akad. Wiss. 1840 p. 104; Müller and Troschel, Syst. der Asteriden, 1842, p. 65, pl. v, fig, 2, *a* and *b*; Sladen, "Challenger" Zool. XXX, 1889, p. 123; Fisher, Bull. U.S, Nat. Mus. 100, III, 1919, p. 180.

Localities.—Gen. Survey. The Sand Flat; between Anchorage Reefs and Mangrove Park (4).

Distribution.—Widely distributed over Pacific and Indian regions.

Specimens of this species were commonly discovered on the sand flats at low tide, where they were partially buried.

Tosia queenslandensis, sp. nov.

(Plate V, figs. 1, 2, 7.)

Locality.—Pixie Reef, 6.vi.1929 (2). Paratype in the British Museum.

Distribution.—Great Barrier Reef, Queensland (Pixie Reef and Masthead Island, Capricorn Group).

Description.—Rays five. Two specimens examined: R. = 17 mm.; r. = 10 mm. R. = 1·7 r. in larger specimen. Smaller specimen: R. = 13 mm.; r. = 7 mm.; R. = 1·8 r.

Rays well produced for a *Tosia*, tapering rapidly towards their extremities. Interbrachial arc comparatively deep and well rounded. Abactinal surface paved by a number of polygonal plates which are, for the most part, arranged in regular radiating series. Each plate is separated from its neighbour by a double row of large well-developed squarish granules, which are plainly larger than those occurring on specimens of *Tosia australis* of the same size.

The abactinal plates are largest centrally, though plates in the distal portion of the median radial series may be larger than their immediate neighbours. This is particularly noticeable in the smaller specimen (R. = 13 mm.). The plates of the abactinal surface are mostly flat or very slightly depressed centrally, or ovate. The exceptions are the last three or four plates in the median radial series, which are conspicuously raised and dome-like—a condition particularly noticeable in the last plate of the series.

All plates of the abactinal surface, including the superomarginals, appear smooth at a casual glance, but minute inspection reveals them to be granular. The granules are not such as will rub off, but are scupltured on the plate, forming a definite and inseparable part of it. In other words the plates may be described as being pitted.

The superomarginal plates vary in number—either eight or nine being present. The inferomarginals number twelve. The superomarginals are not usually large, and are, with the exception of abnormal ones, of approximately uniform size. The inferomarginals are smaller than the superomarginals, particularly near the tips of the rays. Plates near the tips of the rays in both series of marginals are noticeably raised and swollen. A large terminal plate occurs, which is larger than any marginal, and possesses a small, though deep, pit on its tip.

The madreporite is larger than most plates of the abactinal surface. It is triangular with outwardly rounded or bulging sides, and separated from the abactinal plates bounding it by a single row of granules.

Inferomarginal and actinal plates much smoother than abactinals, yet showing faint traces of the type of granulation described above. The actinal plates are, on the whole, smaller than the abactinals. They are flat or slightly convex, and separated from one another by a double row of granules. The marginals are also separated by a double row of granules.

The adambulacral armature consists of a furrow series of two to three short, stout spines of equal length and size. At the back of each comb there are two or three granule-like spinelets. These latter merge into the general granulation.

Colour.—According to the label the colour in life is crimson.

Remarks.—This species is a member of the genus *Tosia*, as understood and restricted by Fisher (1919). Its nearest relative appears to be *Tosia australis*, Gray, but even to this species it is not nearly related. In the first place, *T. queenslandensis* is identifiable by the large and conspicuous terminal tubercle and the resulting marked derangement of the inferomarginal plates; by the deeply sinuated interbrachial arcs and the unusually heavy granulation separating the plates of both surfaces. In addition, the animal is much thicker and more stoutly constructed than any specimens of *T. australis* of the same size seen by me.

Besides the two specimens secured by the British Expedition, there is another in the Australian Museum from Masthead Island, Capricorn Group, Queensland, collected by W. Boardman and M. Ward in 1929. This specimen agrees in detail with the examples from the Barrier Reef.

T. queenslandensis seems to be a rare species, there being only three specimens known. Of the numerous collecting parties to the Great Barrier Reef none but the present expedition has met with it.

Stellaster incei, Gray.

(Plate I, figs. 3—6; Plate II, figs. 2—5.)

Stellaster incei, Gray, Proc. Zool. Soc. Lond. 1847, p. 76; Fisher, Bull U.S. Nat. Mus. 100, III, 1919, p. 326, pl. lxxix, figs. 1–3; pl. lxxx, fig. 1 (and synonymy); H. L. Clark, "The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 29.

Locality.—Low Isles, about one mile north from the Northern Moat, 12 fathoms (1).

Distribution.—"East to the Mozambique coast (Simpson and Brown), India and Ceylon, Mergui Archipelago, Sumatra and Singapore, Philippines to Korea (? Sladen), south to New Guinea, Arafura Sea, Torres Strait, North, North-east and South Australia" (Fisher, 1919); Queensland.

A specimen dredged in 12 fathoms off Low Isles is undoubtedly referable to this very variable species. It has been compared with material in the Australian Museum Collection identified by H. L. Clark, and found to agree in all the specific characters. R. = 82 mm. on the specimen before me, and on the abactinal surface 49 tubercles, and 11 scars of missing tubercles, are to be seen. Each furrow comb is made up of from six to seven (usually seven) very slender spines, which are webbed for a full three-quarters of their length. The webbed section is conspicuously corrugated owing to the presence of the spines. The subambulacral spines are flat and rounded at their free extremity. They occur usually in pairs, one spine being a little longer than its fellow. Rarely three spines are found together, and then the median spine is slightly larger than its fellows, which are more or less equal in size. Usually a small tubercle occurs on the outside of each spine, near the base, and just above the place of articulation. The large pincer-shaped pedicellariae, referred to by Fisher, agree with his account.

In a specimen from 25 miles S.E. of Double Island Point, Queensland, 35 fathoms, identified by H. L. Clark as *Stellaster incei*, the subambulacral spines are equal in number to those of the specimen before me, but very unequal in size. The spines of the furrow comb are webbed for less than half their length, and the abactinal tubercles are very few. Pedicellariae occur as described by Fisher.

In a specimen of *Stellaster incei* from Western Australia, which is in the Australian Museum collection, the characters are similar in most respects to those of the present examples, but there is a difference in the relative lengths of the spines of the furrow comb. The central pair are long and equal in length. The next adjoining pair are closely adpressed to the central pair, and are substantially shorter. The next two, which are on the outside, are only half as long as the central pair. A seventh spine sometimes occurs in the comb, and is usually stumpy and barely discernible. The spines of the comb are inconspicuously webbed for only a short distance.

Fisher's remark (*loc. cit.*, p. 328) that the "relationship between *incei* and *equestris* is by no means clear," has led me to examine a specimen of *equestris* in the Australian Museum from Nagasaki, Japan, 57 fathoms, collected by the "Vega" expedition in 1879, and identified presumably by Prof. T. Odhner, of Stockholm, from whom the specimen was received. In this specimen R. = 58 mm., and, after comparing it with a specimen of *S. incei* (R. = 59 mm.) from Albany Passage, North Queensland, 9–12 fathoms, collected by M. Ward, I prepared the following table with a view to providing a satisfactory means of discriminating the two species.

Stellaster incei. (Specimen from Albany Passage, North Queensland, 9–12 fathoms. R. = 59 mm.	*Stellaster equestris.* (Specimen from Nagasaki, Japan, 57 fathoms. R. = 58 mm.).
(1) Abactinal surface fairly rugged, uneven when dry, and studded with tubercles.	(1) Abactinal surface comparatively smooth, when dry, and devoid of tubercles.
(2) Superomarginal plates conspicuously tumid and well defined.	(2) Superomarginal plates only very slightly tumid and not well defined.
(3) Superomarginal plates in interbrachial arc comparatively narrow—2·75 mm. wide across middle.	(3) Superomarginal plates in interbrachial arc comparatively wide—3·75 mm. across middle.
(4) Inferomarginal plates narrow in interbrachial arc—3 mm. wide across middle.	(4) Inferomarginal plates in interbrachial arc comparatively wide—4 mm. wide across middle.
(5) Superomarginal and inferomarginal plates low. Measurement from top of superomarginal plate to bottom of inferomarginal plate in middle of interbrachial arc, 5 mm.	(5) Superomarginal and inferomarginal plates high. Measurement from top of superomarginal plate to bottom of inferomarginal plate in middle of interbrachial arc, 8 mm.
(6) General granulation comparatively coarse.	(6) General granulation fine.
(7) Rays noticeably narrow at base.	(7) Rays wide at base.
(8) Only adambulacral pedicellariae occur (at this age).	(8) Ventrolateral as well as adambulacral pedicellariae present.
(9) Subambulacral spines 2–4 (usually 3) in number, and unequal in size.	(9) Subambulacral spines single and of considerable size.

In the preceding table it will be noticed that use has been made of the width of the marginal plates, a character also used by Fisher (*loc. cit.*, pp. 327 and 328) in separating *incei* from *equestris*, but that author was unable to state at the time whether this character was constant in *equestris*. Little reliance is usually placed on granulation as a distinguishing character, and with only a single specimen of *equestris* before me, I can form no conclusion regarding its value as a specific differential. I have here simply recorded my observations on the available material.

Stellaster princeps, Sladen.

(Plate I, figs. 1 and 2; Plate II, fig. 1.)

Stellaster princeps, Sladen, "Challenger" Zool. XXX, 1889, p. 323, pl. lviii, figs. 1, 2; H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 29.

Locality.—Western Australia (Australian Museum).

Distribution.—Known only from Western Australia and Booby Island, Torres Strait.

Representatives of this species were not obtained with the present collection, and the specimen before me, which is from Western Australia, is mentioned here only because of its importance. According to Clark (*loc. cit.*) the species is known only from the "Challenger" specimens from Booby Island, Torres Strait, and no further record can be found.

The specimen before me, which is undoubtedly *S. princeps*, has five rays: R. = 128 mm.; r. = 45 mm.

The abactinal surface agrees exactly with Sladen's description. Seven longitudinal series of plates occur at the base of the ray, and either three or four midway along that structure. Conical and sharply pointed tubercles occur on the plates in the positions described, and the almost bare median radial series forms a very striking character.

The number of superomarginal plates (22) is exactly the same as that recorded by Sladen, and they are in complete accord with that author's description.

The spines on the inferomarginal plates evidently vary considerably in number, though in character and arrangement they are constant. Sladen gives three as the usual number of spines to each series, but the following observations on the present specimen show that the number varies.

The inferomarginals at the extreme tip of the ray are destitute of spines. Usually three, sometimes four, spines occur arranged in a lateral position, and in an oblique series on inferomarginal plates near the tip of the ray down to the interbrachial arc. In the interbrachial arc an oblique series of four or five may occur, and sometimes alongside these on the same plate a second series of two may be present, thus making a total of six or seven spines to one inferomarginal plate. The upper or outermost spine is always the longest and broadest; the longest spine measured on the present example is 7 mm.

The adambulacral plates and their armature, together with the two-valved pincer-shaped pedicellariae described as occurring in the immediate vicinity, are exactly as set down by Sladen. Likewise the actinal inter-radial areas and the position of the two-lipped valvate pedicellariae are in complete accord with his description.

Anthenea tuberculosa, Gray.

(Plate V, figs. 4—6.)

Anthenea tuberculosa, Gray, Proc. Zool. Soc. Lond. 1847, p. 77; H. L. Clark, "The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 29, pl. vi, fig. 1 (and synonymy); H. L. Clark, Rec. Aust. Mus. III, 4, 1928, p. 385.

Localities.—Station XII. 24.ii.1919. Penguin Channel, 10 to 15½ fathoms, rock and shell gravel, mud on edges of pit (1). Station XIV. 7.iii.1929. Half mile S.E. Lizard Island, 19 fathoms, shell gravel, 3 dredges of 20 to 30 minutes each, rich Halimeda (1). Station XXII. 11.iii.1929. To E. of Snake Reef, 13½ fathoms, mud with forams and shells (1).

Distribution.—North Australia round to North Queensland.

Three juvenile specimens in the collection (R. = 22·5 mm., 16 mm., 12·5 mm.) agree so well with Sladen's* figures that I have no doubt as to their identity. Although Sladen was not sure of the identity of his "Challenger" material, Clark (*loc. cit.*) states that in his opinion Sladen was right in naming his specimens *tuberculosa*, Gray.

Oreaster australis, Lütken.

(Plate VI, figs. 1—6; Plate VII, figs. 1—4; Plate VIII, figs. 5—6;
Plate X, figs. 1—4.)

Oreaster australis, Lütken, Vidensk. Medd. naturh. Foren. Kjöb. 1871, pp. 253, 263.

Pentaceros australis, Koehler, Echinod. Indian Mus. pt. vi, Asteroidea, 2 (Shallow Water Asteroidea), 1910, p. 93, pl. x, fig. 2; pl. xiii, fig. 1.

Oreaster australis, H. L. Clark, Biol. Res. F. I. S. "Endeavour," IV, 1916, p. 49.

Oreaster hedemanni, Koehler (*loc. cit.*), p. 96, pl. x, fig. 6; pl. xi, fig. 7.

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* Sladen, "Challenger" Zool. XXX, 1889, p. 340, pl. lvi, figs. 5–8.

Locality.—Station XIX. 10.iii.1929. About half mile N. of Eagle Island, 10 fathoms, shell gravel, rich Halimeda (6).

A series of twelve specimens collected by the expedition from deep water are referable to this species. In determining the specimens, I have had the use of material collected by the " Endeavour," and named *O. australis* by H. L. Clark.

Earlier authors apparently did not have sufficient material at their disposal to describe the various growth stages of the species, and without this guidance the task of determining the growth stages and individual variation of the present series would have been doubly difficult. A critical study of the present series has led me to the belief that they all belong to the single species *australis* despite obvious differences, all of which I believe to be due to growth or individual variation. On this assumption, I am able to clear up important points concerning two other species of the genus, *gracilis* and *hedemanni*, as well as to attempt to establish more firmly *O. australis*.

I am of the opinion that *O. gracilis* is a distinct species and not merely a form of *O. australis*, as Clark (*loc. cit.*) thought it might be. As regards *hedemanni*, the juvenile specimens in the present series show it clearly to be a synonym of *australis*. Koehler (*loc. cit.*), who examined Lütken's type-specimen of *hedemanni*, gives a full description and excellent figures, and mentions that Lütken himself considered his specimen immature.

Koehler's description and figures fit the small and immature specimens of *O. australis* before me so well that there is no doubt in my mind as to the identity of *hedemanni*.

The following table (p. 249) is an attempt to set out briefly the differences due to growth and variation, together with the points of resemblance found in the members of the present series of *O. australis*. The specimens have been sorted into three sections, each representing a definite growth stage. Six are undoubtedly juveniles, five are young adults, and one is considered an old adult.

Only the specimens collected by the British expedition are dealt with in the following table, as they in themselves form a definite series.

The table will show how unreliable are the tubercles, and to a certain degree the spines of the adambulacral armature, as an aid to determining species even when specimens of approximately the same size are compared. Bell (1884) has made an attempt to define specific limits, but his work does not go far enough. Furthermore, he relies to a considerable extent upon the tubercles to distinguish between species; for example, *O. alveolatus* is said to be identifiable by the constant possession of inferomarginal tubercles (spines). This character, and indeed others relating to size, arrangement, and occurrence of tubercles, are perfectly worthless in my opinion for species such as *O. australis* and *O. alveolatus*. The six adult specimens in the present collection could easily, on such grounds, be split into three seemingly distinct species; but seeing that they all came from the same haul and possess characters in common, apart from the tubercles, such a procedure would, in the light of our knowledge of the Oreasters, be perfectly ridiculous.

Unfortunately, a paper by Döderlein (Zool. Jahrb. Syst., Jena, XL, pp. 409–440, 1916) upon the genus *Oreaster* is not available to me; but it seems perfectly clear that when more material is at hand for study purposes there will be far fewer valid species in the genus and much less difficulty in determining them.

It is quite possible, and even probable, that some authors may consider the specimens in the series before me as referable to *O. alveolatus*. This has not been overlooked, and in

	Juvenile specimens	Young adults.	Old adults.
Rays	(*a*) (Largest specimen) R. = 33·5 mm., r. = 13·5 mm., br. (between 2nd and 3rd superomarginal) 11 mm. R. = 2·4 r. and 3 br. (*b*) (Smallest specimen) R. = 20 mm., r. = 7·5 mm., br. (between 2nd and 3rd superomarginal)=6 mm. R.=2·6 r. and 3·3 br. (*a–b*) Ray tapering gradually.	(*a*) (Largest specimen) R. = 91 mm., r. = 36 mm., br. (between 2nd and 3rd superomarginal) 29 mm. R. = 2·5 r. and 3 br. (*b*) (Smallest specimen) R. = 78 mm., r. = 33 mm., br. (between 2nd and 3rd superomarginal) 31 mm. R. = 2·3 r. and 2·5 br. (*a–b*) Rays tapering gradually.	(*a*) (The only specimen) R. = 111 mm., r. = 42 mm., br.) between 2nd and 3rd superomarginal) 39 mm. R. = 2·6 r. and 2·8 br. (*a*) Rays stout and stumpy.
Disc	(*a*) Normally elevated, not conspicuous. (*b*) Slightly elevated.	(*a*) Evenly swollen and elevated. (*b*) Swollen and elevated, mostly centrally.	(*a*) Evenly swollen and well elevated; thick and massive.
Reticulate pattern (on abactinal surface)	(*a*) Becoming discernible. (*b*) Absent.	(*a*) Present, but showing signs of fading, particularly on rays towards extremities. (*b*) Well developed and uniformly distributed.	(*a*) Present on disc; ill defined.
Papular pores and areas (abactinal surface)	(*a*) Pores 1–9 in number; traces of irregularity in distribution. (*b*) Pores single or paired; arranged regularly.	(*a*) Pores numerous; areas merging into one another on rays. (*b*) Pores numerous; areas bounded by lines forming reticulate pattern.	(*a*) Pores numerous; areas forming continuous bands on rays and sometimes bounded by the lines of reticulate pattern on disc.
Tubercles:			
1. Pentagon formed by primary radials	(*a*) Well developed, conical and sharply pointed. (*b*) Prominent, sharply pointed and conical	(*a*) Large and well developed, conical, though inclined to be bluntly pointed. (*b*) Large, well developed and conical.	(*a*) Large and heavily developed, stumpy and roundly pointed—not strictly conical.
2. Granulation of tubercles	(*a*) Evenly clothed except for tip, which is smooth and nipple-like. (*b*) Ditto.	(*a*) Evenly clothed except for tip, which is smooth and nipple-like. (*b*) Ditto.	(*a*) Evenly clothed, except for tip, which is a bare rounded extremity, or represented by a series of large smooth granules.
3. Tubercles on median radials	(*a*) Present on about half the plates. (*b*) Only of isolated occurrence.	(*a*) Present on nearly every plate of series. (*b*) Present on most plates of series.	(*a*) Present on nearly every plate of series.
4. Tubercles on other plates of abactinal surface	(*a*) Occur fairly numerously as enlarged granules. (*b*) Occur sparingly as large granules.	(*a*) Fairly prominent and well developed, arranged in two or three rows and placed at angles of reticulate pattern. (*b*) Ill-developed (this character varies in young adults of approximately the same size); arranged in two or three rows and placed at angles of reticulate pattern.	(*a*) Prominent; inclined to be roundly pointed and stubby; in two or three rows, placed at angles of reticulate pattern.
5. Tubercles on superomarginals	(*a*) Fairly prominent, largest on plates in interbrachial arcs and near extremities of rays. (*b*) Present, though small, largest on plates near extremities of rays.	(*a*) Fairly well developed, though mostly confined to plates in interbrachial arcs and near tips of rays. (*b*) Wanting (young adults between sizes *a* and *b* are all provided with fairly well-developed tubercles.)	(*a*) Wanting.
6. Tubercles on inferomarginals	(*a*) Comparatively well developed, especially near tips of rays. (*b*) Present only on plates near tips of rays. Here they are very prominent and comparatively large for the specimen.	(*a*) Occur sparingly on plates in interbrachial arcs and near tips of rays. (*b*) Conspicuous, confined mostly to plates in interbrachial arcs.	(*a*) Wanting.
Number of superomarginals	(*a*) 15–16. (*b*) 12.	(*a*) 18. (*b*) 16–17.	(*a*) 19–12.
Number of inferomarginals	(*a*) 15–16. (*b*) 12.	(*a*) 19–20. (*b*) 18.	(*a*) 20.
Pedicellariae:			
1. Low bivalved slit-like	(*a*) Present both surfaces. (*b*) ,, ,, ,,	(*a*) Present both surfaces; rare on abactinal surface; small. (*b*) Present both surfaces; very minute; rare on abactinal surface.	(*a*) Present both surfaces; comparatively conspicuous.
2. Upright forceps pedicel	(*a*) Present both surfaces; rare on abactinal surface; confined mostly to ambulacral furrow actinally. (*b*) Absent (so far as can be made out).	(*a*) Present both surfaces; confined to ambulacral furrow actinally. (*b*) Ditto.	(*a*) Present both surfaces; fairly numerous abactinally and confined to ambulacral furrow actinally.
Adambulacral armature (furrow spines)	(*a*) 6–8. (*b*) 6–7.	(*a*) 8–10. (*b*) 8–10.	(*a*) Usually 8. The series is entirely hidden by the subambulacral spines.
Subambulacral spines	(*a*) 1–3. (*b*) 1–3.	(*a*) 2–3. (*b*) 2–3.	(*a*) 2–3.

order to ascertain the differences between that species and *O. australis*, I have used specimens named by H. L. Clark as *O. australis*, Koehler's description and figures of *O. australis*, and three specimens from New Caledonia attributed mainly on the ground of the locality to *O. alveolatus* which are in the collections of the Australian Museum (see figure of one; R. = 90 mm.) I can find no tangible differences to separate any of them. This would point to the conclusion that *O. alveolatus* is a synonym of *O. australis*—a conclusion which, in my opinion, the study of further material will substantiate. Scarcely any of the descriptions and figures of *O. alveolatus* wholly agree with one another. Even the specimens before me from New Caledonia cannot be said to agree very well with any existing records.

In order to make perfectly clear the character of the specimens upon which the preceding table and notes are based, as many as reasonably possible have been figured.

Oreaster nodosus (Linnaeus).

Asterias nodosa, Linnaeus, Syst. Nat., ed. X, 1758, p. 661.
Oreaster nodosus, Fisher, Bull. U.S. Nat. Mus. 100, III, 1919, p. 346, pl. cii, fig. 2 (and synonymy).

LOCALITY.—Gen. Survey; 23.4.1929, Western Moat (1).

DISTRIBUTION.—Region of Indian Ocean, East India Islands (north to Luzon), thence to New Caledonia and N.E. Australia in the Pacific.

Only a single specimen of this species was collected by the expedition. Specimens in the Australian Museum collection show the species to be fairly common in and around Port Denison, Queensland, where it lives between tide-marks during the winter season; it retires in the summer months to deeper water to avoid the severe seas of the monsoonal weather.

The colour is extremely variable, according to the careful colour notes taken by E. H. Rainford, of Bowen, Queensland, who states that the predominating colours are crimson and white.

The specimen from Low Isles before me is a juvenile measuring R. 39 mm.

Culcita novaeguineae, Müller and Troschel.

(Plate III, figs. 2 and 4; Plate IV, figs. 3 and 4.)

Culcita novaeguineae, Müller and Troschel, Syst. der Asteriden, 1842, p. 38; Goto, J. Coll. Sci. Tokyo, XXIX, Art. 1, 1914, p. 519, pl. xvii, figs. 252–262; H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 32, pl. v, fig. 1.

LOCALITIES.—Low Isles, Gen. Survey, mud flat (adults). (Juvenile specimens were collected under stones in vicinity of Western Moat and Southern Moat, Rampart Y, 6.iv.1929 (7).)

DISTRIBUTION.—Torres Strait and Queensland Coast; from Mozambique to Society Islands, and northward to the Andaman Islands, and to Kagoshima, Japan.

With the exception of the well-known *L. laevigata*, this species was as common as any other asteroid at Low Isles. Clark* records this species from "The Great Barrier Reef, Queensland," being unable to give a precise locality. He states that "if the locality were in the vicinity whence most of the present collection came" (between 17° and 19° S. lat.) "it would be a notable extension to the range of the genus." The present record,

* H. L. Clark, Rec. Aust. Mus. XV, 1926, p. 185.

then, establishes the fact that the species occurs in the immediate vicinity of the area mentioned by Clark.

The youngest examples were found sheltered in reefs of dead and living coral, while the older ones were usually discovered on the open flat at low tide in about one to three feet of water. The two youngest specimens of the series of six before me bear a striking resemblance to those figured by Koehler,* and the remaining four agree with the key given by Goto (*loc. cit.*).

In the more mature specimens of the present series both the poriferous and net-like non-poriferous areas bear spiniform tubercles, which are noticeably bigger on the last-mentioned area. In the largest specimen, which is about half grown, some of the spiniform tubercles on the poriferous areas are as big as those on the non-poriferous areas, but as this character is not seen on younger examples it is obvious that it is due to age. The marginal zone is destitute of papulae—a feature most plainly visible on the largest specimen before me.

On the largest specimen five conspicuous humps of irregular shape occur in a more or less regular situation in the centre of the abactinal surface. Each is situated above and midway between the upturned extremities of the ambulacral furrows. The tops of the humps are seen to be constituted by extremely well-developed and thickened non-poriferous areas, and the humps themselves are produced by the sinking of the weaker surrounding non-poriferous areas during the process of drying and contracting. Younger examples show a thickened series of non-poriferous areas extending from near the margin midway between the rays up to the centre of the abactinal surface, but apparently these are not sufficiently developed to cause humps when dry and contracted.

In the youngest example the actinal plates are conspicuous. Each is clothed in granules, but those in the centre of each plate are much larger and coarser than their surrounding fellows. The large granules number from three to twelve. The whole series of specimens shows that, as the adult condition approaches, the well-defined areas of granules on the actinal surface become more indistinct, and in the largest example the grouping of the granules in the centre of each plate is almost indiscernible. Age does not seem to affect the number of inner adambulacral spines, which vary from five to six in each group, both in the smallest and largest example.

Of the varieties of the species, the present specimens seem to be nearest to var. *acutispinosa*, on account of the continuous poriferous areas, especially near the margins, but the abactinal surface cannot be said to be covered by the numerous coarse spines described as occurring on that variety.

Asterope carinifera (Lamarck).

Asterias carinifera, Lamarck, Anim. s. Vert. II, 1816, p. 556.
Asterope carinifera, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 33, pl. v, fig. 2.

LOCALITIES.—Gen. Survey; Low Isles, Western, Southern and Middle Moats (2).

DISTRIBUTION.—Indo-Pacific. "It ranges from Mozambique, Zanzibar, and the Red Sea on the west, to the Hawaiian and Society Islands on the east, and from Queensland and New Caledonia on the south to Okinawa, Riu-kiu Islands on the north. It is also reported from the Galapagos Islands, Panama, and La Paz, Lower California, but these records are all old and need verification " (H. L. Clark, 1921).

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* Koehler, Echinod. Indian Mus. pt. vi, Asteroidea 2 (Shallow Water Asteroidea), 1910, pl. ix, figs. 4, 5.

The specimens collected or seen on the reefs of sand and coral were all of a very dark chocolate hue. As stated by Clark (*loc cit.*), some difficulty was experienced in seeing them, as their colour rendered them inconspicuous.

Fromia milleporella (Lamarck).

Asterias milleporella, Lamarck, Anim. s. Vert. II, 1816, p. 564.
Fromia milleporella, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 40.

Locality.—Low Isles (1).

Distribution.—" Red Sea, Mauritius, Madagascar, Ceylon to Samoa and Fiji Islands, *via* the Moluccas and Southern Philippines; New Caledonia; also Riu-kiu Islands, Japan " (Fisher, 1919). Mer, Torres Strait (H. L. Clark, 1921) and Low Isles, Queensland.

Prior to 1926, this species was not known from the mainland coast of Australia. Clark,* in that year, recorded six specimens from Coates Reef, Outer Great Barrier Reef, between 17° and 19° S. lat. The present record extends the range some little distance northward from that locality.

Only a single specimen exists in the present collection, and it was found among dead and living coral between tide-marks. The specimen was apparently mutilated at an early age, as two of the five arms are extremely short. R. = 3·4 r. and 3·1 br. Only one madreporite is present, but, after comparing the specimen with Queensland examples in the Australian Museum identified by H. L. Clark, I have no doubt as to its identity.

Nardoa pauciforis (von Martens).

(Plate III, fig. 3; Plate IV, fig. 6.)

Linckia pauciforis, von Martens, Arch. Naturgesch. XXXII, pt. 1, 1866, p. 69.
Nardoa pauciforis, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 51 (and synonymy).

Localities.—Gen. Survey, Low Isles; found exposed on reefs of dead and living coral between tide-mark (2). Batt Reef, off Port Douglas, N. Queensland; in same habitat as above (3).

Distribution.—Flores, Philippines, Amboina, Queensland, Erub and Mer, Torres Strait.

The discovery of this species at Low Isles and Batt Reef is not remarkable, as it has already been collected at Green Island, near Cairns, and at localities in Torres Strait (*fide* Clark, *loc. cit.*). The present record merely links up these areas.

The species was noticeably common both at Low Isles and Batt Reef, and is, as noted by Clark, extremely sluggish, the individuals observed making no attempt to hide for protection or to avoid the hot sunshine. Of the five selected specimens before me the one with R. = 95 mm. is the largest. The papulae in each area vary considerably in number, and the comparative smallness of the abactinal plates is noticeable. In the largest example the number of abactinal plates across the base of the ray between the two superomarginal series comes within the limit (12–13) set by Clark. In some cases, however, the number increases to fourteen, while in the smallest example (R. = 74 mm.) only eleven are to be counted.

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* H. L. Clark, Rec. Aust. Mus. XV, 1926, p. 185.

The colour in life of the species agrees well with Clark's description.

Nardoa novaecaledoniae (Perrier).

(Plate IV, fig. 1 ; Plate V, fig. 3.)

Scytaster novaecaledoniae, Perrier, Archiv Zool. Exp. Gén. IV, 1875, p. 426.
Nardoa novaecaledoniae, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 52 (and synonymy).

LOCALITY.—Low Isles ; found exposed on reef of dead and living coral between tide-marks (1) ; Yonge Reef, Inner Moat, 6th June, 1929 (1).

DISTRIBUTION.—Mer, Torres Strait, Queensland, New Caledonia, Philippines, Andaman Islands, Maldives (? Minikoi and New Ireland), Ceylon, Moluccas.

A single four-rayed specimen of this species was handed to me, by a member of the collecting party, as an abnormal *N. pauciforis*. By the colour and shape of the specimen one could easily mistake it for its commoner ally, and the confusion was not noticed by any of us until after a later and more careful examination had been made. The likeness in colour of the two species has been already recorded by Clark (*loc. cit.*), who examined specimens from Green Island, near Cairns, and Mer, Torres Strait, where both species were found to occur together. R. = 81·5 mm. in the present example. The abactinal plates are not crowded on the disc or on the basal end of the rays, and in both of these areas the plates range from 2 to 4 mm. in diameter. Running from about the middle of the ray towards the distal or free extremity, the abactinal plates are seen to become more crowded, with the result that, at, and near the extreme tip, they are very numerous, small, and densely packed together. The abactinal plates on the extremities of the rays are, like those on the disc and basal ends of the rays, provided with conspicuous central granules.

Nardoa rosea, H. L. Clark.

(Plate VIII, fig. 7.)

Nardoa rosea, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 53, pl. x, fig. 1 ; pl. xxix, figs. 1, 2.

LOCALITY.—Station XX. 10.iii.1929. About ¼ mile N. of Eagle Island, 6 fathoms, coral (1).

DISTRIBUTION.—Known only from Australian waters. Murray Islands, Torres Strait ; Eagle Island, Queensland ; Heron Island, Capricorn Group, Queensland.

This sea-star is not common, as past and present records show. Further, I have never seen it alive on any part of the Great Barrier Reef that I have visited.

The single specimen collected by the expedition has its rays very much distorted but the R. is calculated to be about 72 mm. It agrees perfectly with the original description and shows no variation.

That adult specimens do not vary is confirmed by another specimen in the Australian Museum from Heron Island, Capricorn Group, Queensland. This specimen is also responsible for the extension of the known range of the species to a considerable distance south of Low Isles.

Linckia guildingii, Gray.

Linckia guildingii, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 285; H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 67.

Locality.—Yonge Reef, Outer Barrier, Inner Moat, 5.vi.1929 (1).

Distribution.—Almost circum-tropical. See Clark (*loc. cit.*) for complete range.

With characteristic clarity Clark has provided a means by which this species can be readily recognized. The single specimen before me is labelled the "Brown Linckia," together with the information that "it was nearly this colour" (dull grey-brown as described by Clark for dry specimens) "when alive—no blue." This, with other characters of a structural nature, leaves no doubt as to the identity of this specimen.

Although large (R. = 125 mm.) the specimen is by no means of a record size, for Clark refers to a specimen from Bermuda with R. = 215 mm.

Although only one specimen of the species was secured, T. A. Stephenson, a member of the expedition, informs me (*in litt.*) that the species was "very common on Yonge and Ribbon Reefs."

Linckia laevigata (Linnaeus).

(Plate III, fig. 1; Plate IV, figs. 2 and 5.)

Asterias laevigata, Linnaeus, Syst. Nat., ed. x, 1758, p. 662.
Linckia laevigata, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 64, pl. ix, figs. 1, 2; pl. xxvi, fig. 1 (and synonymy).

Locality.—Low Isles; exposed on reefs of dead and living coral between tide-marks, especially on Fungia and Madrepore Moats (4).

Distribution.—See H. L. Clark, 1921, p. 65, for detailed and complete information.

This handsome blue species was the commonest and most conspicuous sea-star both on Batt Reef and Low Isles, but examples from only the last-mentioned locality were collected. The largest of the four specimens collected has R. = 157 mm. and the smallest R. = 56·5 mm. It is noticeable that the two smallest examples, although showing little difference in ray measurement, exhibit a comparatively marked difference in the breadth of these structures. The individual mentioned above with R. = 56·5 mm. has br. = 13 mm., while the second smallest has R. = 63·5 mm. and br. = 10 mm. Although the difference in breadth is only 3 mm. it is considerable, if we take into account the almost equal length of the rays. When the two specimens are compared, the rays of the smaller specimen could be properly described as stumpy and fairly thick, while those of its slightly larger fellow should be called slender.

Clark (*loc. cit.*) showed that this type of variation is not unknown in the species, but, in his view, it occurred only when the specimens were from different localities. The present record demonstrates that such variation can take place in specimens from the same locality.

Ophidiaster propinquus, sp. nov.*

(Plate XII, figs. 5, 11, 16, 18.)

LOCALITY.—Ribbon Reef, 4.vi.1929; seaward sloping zone (1).

DESCRIPTION.—R. = 26·5 mm.; r. = 5·5 mm.; br. (at base of ray) = 5 mm. R. = 4·8 r. and 5·03 br. Disc distinct, though not prominent. Rays slightly unequal in length, semicircular abactinally, and flat, or nearly so, actinally. The width of the rays changes little throughout their entire length, the slight taper becoming noticeable only upon close examination. The plates of the abactinal surface are arranged in more or less regular order, especially near and at the margins, where a shallow though well-marked furrow separates them longitudinally. Mid-dorsally, however, the various series of plates become slightly disarranged and tend to intermingle with one another.

The marginal plates of both series are well marked, much more so than those near the top of the abactinal surface. The granulation of the abactinal surface is even. Only the plates of the marginal series bear larger granules centrally.

The papular areas are not clearly defined, nor arranged with any regularity except near the marginals. The number of papulae to an area varies from 1–7. The papulae are scarce on the abactinal surface of the disc, where they usually occur singly or in pairs. The areas are not, on the whole, deeply sunken.

The terminal plate is slightly over 1 mm. across. It is bare, and in one case sparsely pitted. The madreporite is smooth, well channelled, and measures 1 mm. in diameter.

The plates of the actinal surface are arranged in a very regular series. Three series of actinolateral plates occur. The actinal plates are much coarser in their granulation than the plates of the abactinal surface, and moreover, their central areas bear granules of comparatively large size.

The furrow spines are arranged two to a plate. They are of equal size and definitely club-shaped. Each pair of spines, not each individual spine, is separated from its adjoining fellow pair by small granules varying in number from one to three. Usually three granules occur. At the back of the furrow series, and separated from it and from one another by one or two rows of small granules, are two rows of blunt, stumpy, spine-like tubercles, two of which correspond to three furrow spines. The spine-like tubercles of the outer row, although smaller. correspond to those of the first or inner row. Outside the second series there occur occasionally further spine-like granules or tubercles, which, although merging in some cases into the spine-like tubercles of the second series, are usually separate, and not arranged in any continuous regular order.

No pedicellariae.

Colour.—Pale biscuit yellow with darker blotches abactinally (specimen dried after a short preservation in alcohol).

Affinities.—The closest known relative of this species appears to be *O. squameus* Fisher. *O. propinquus* has been compared with a specimen of *O. squameus* from Mer, Murray Islands, Torres Strait, kindly lent by H. L. Clark, together with Fisher's original description and figures. The characters found separating *O. propinquus* from *O. squameus* are as follows: Papular areas and pores not conspicuous. Plates not markedly convex. Granules not coarse; those covering abactinal plates never noticeably enlarged centrally.

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* Specific name indicates the species' affinity with *O. squameus*, Fisher.

Granules occur between each *pair* of furrow spinelets, not between each spinelet. *Two* rows of granule-like tubercles outside furrow series. No granules with the appearance of scales.

Tamaria, Gray.

Tamaria, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 283.

This genus has, in recent years, been subjected to a comparatively brief overhaul, but lack of material, coupled with scanty and sometimes contradictory information, has seriously hampered workers in deciding on the validity of its various species. Even the genus cannot be said to be secure in its present status.

A study of material on loan from the Museum of Comparative Zoology, Cambridge, Mass., U.S.A., of material secured by the expedition, photographs of authentic material in the British Museum (Nat. Hist.) and specimens in the Australian Museum has led me to the following main conclusions:

That *T. fusca*, Gray, is not a very variable species, and that, in Australian waters at least, it is distinct and easily recognizable.

That the genus *Tamaria* is of doubtful validity.

That many specimens associated with *T. fusca* by earlier authors belong to distinct species.

That Bell's records of species are unreliable owing to his errors in identification.

That Sladen's *tuberifer* should be relegated to the synonymy of Bell's *megaloplax* on the ground of priority.

That distinct species occur in the same zone.

That the species of the Queensland coast are distinct from those at present known to occur in western and north-western waters of the Continent.

In brief, I believe the status of the various species mentioned to be as follows:

(a) *Tamaria fusca*, Gray. Valid.

(b) *Tamaria fusca* (Fisher's 1919 specimens). From available information they are identical with Gray's specimen.

(c) *Tamaria fusca* (Perrier's record). Valid. (Gray's specimen used.)

(d) *Tamaria fusca* (Studer's "Gazelle" specimens labelled *O. fuscus* and mentioned by Clark, 1921) referable to *T. hirsuta*, Koch.

(e) *Tamaria* sp. Bell's Zanzibar material. Most certainly not *Tamaria fusca*, Gray.

(f) *Tamaria fusca* (Clark's 1921 Holothuria Bank specimens). Not *T. fusca*, Gray, but the two species described by Koehler—*ornata* and *hirsuta*.

(g) *Tamaria lithosora*, H. L. Clark. Valid ?

(h) *Tamaria megaloplax*, Bell (Bell's specimens from Holothuria Bank). See Clark's reference to these specimens under (f).

(i) *Tamaria megaloplax*, Bell. Valid. ("Alert" specimen from Albany Island.)

(j) *Tamaria ornata*, Koehler. Valid.

(k) *Tamaria hirsuta*, Koehler. Valid.

(l) *Tamaria tuberifera*, Sladen ("Challenger" and subsequent material), in the synonymy of *T. megaloplax* Bell (Albany Island specimen).

Tamaria fusca, Gray.

(Plate IX, figs. 4—7; Plate XI, figs. 1, 2, 3, 4, 7, 8; Plate XII, figs. 1, 4, 6, 7, 10, 15, 17, 19.)

Tamaria fusca, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 283.
Ophidiaster fuscus, Perrier, Arch. Zool. exp. gén. 1875, p. 396; Fisher, Bull. U.S. Nat. Mus. 100, 1919, p. 388, pl. xcv, figs. 5, 5*a–c*; pl. ciii, fig. 4; pl. civ, fig. 1; pl. cxi, figs. 5, 6.
Tamaria fusca, Livingstone, Rec. Aust. Mus. XVIII, No. 1, 1930, p. 22, pl. viii, figs. 2–5.

Localities.—Station XVI, 9.iii.1929; about ½ mile W. of N. Direction Island, 20 fathoms, stony, five juveniles; Station XIV, 7.iii.1929; ½ mile S.E. Lizard Island, 19 fathoms, shell gravel, rich Halimeda, one juvenile; off Lindeman Island, Whitsunday Passage, Queensland, 9 fathoms, 1929, 1 specimen possibly adult, Austr. Mus. (this specimen was recorded and figured by me in a previous paper); Port Denison, Queensland, one seemingly half-grown example, Austr. Mus.

Distribution.—Philippine Islands, Celebes and coast of North Queensland (other records exist, but I believe the specimens were incorrectly identified).

Photographs of Gray's type of *fusca* kindly supplied by the authorities of the British Museum (Nat. Hist.) have enabled me to establish definitely the status and characters of the species. In the past errors have been made in identification owing to the lack of definite information and other causes. In order to avoid or reduce further complications the photographs before me have been reproduced in this work.

The species has the reputation of being one of the most variable in the family. This is, I think, not wholly warranted, as all the specimens available to me, which collectively form a good series illustrating growth stages, point to an opposite conclusion. Fisher (1919) and Clark (1921) have, in my opinion, relegated too much to the synonymy of *fusca* and assumed too much variation.

Six juveniles before me are undoubtedly referable to *fusca*, and none of them is similar to specimens previously regarded as young or immature examples of *fusca*. Further, the young of *fusca* are easily recognized and associated with the adult.

Fisher's (1919) specimens from the Philippines and Celebes are referable to *fusca*, and the information concerning them was used in determining a specimen from Whitsunday Passage, Queensland, dealt with in an earlier paper (*loc. cit.*, 1930). I see no reason to question that determination after examining photographs of Gray's type. A study of this specimen together with a smaller one in the collections of the Australian Museum and of the juveniles collected by the expedition has caused me to review and alter the synonymy submitted tentatively by H. L. Clark. *Linckia megaloplax*, Bell (Albany Island specimens and Holothuria Bank specimens) should have no place in the synonymy of *fusca*. *O. ornatus* and *O. hirsutus* of Koehler are apparently distinct species. The specimens available to me suggest that Koehler was justified in separating the two forms from one another and from *T. fusca*.

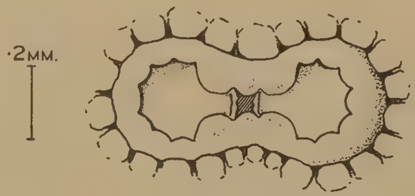
A "Gazelle" specimen, the property of the Museum of Comparative Zoology, Cambridge, Mass., U.S.A., named *Ophidiaster fuscus* by Studer and referred to by Clark (1921) under the heading of *Tamaria fusca*, is before me. I am convinced it does not belong to Gray's species, but is referable to *T. hirsuta*, Koehler. Further mention of it is made under that heading.

After examining photographs of specimens of Bell's supposed *O. fuscus* from Zanzibar I find that they do not represent examples of *fusca* of Gray, and am at a loss to place them.

They may be related to specimens identified and listed by Simpson and Rudmose-Brown (1910) as *Linckia marmorata*. The photographs have been reproduced for the benefit of future workers wishing to investigate the question of the African examples, as well as to support my opinion as to the status of Bell's material.

Description.—Rays five (measurements given under the heading of material examined). Disc noticeably elevated. The rays taper evenly and rapidly from base to a comparatively sharp point. In a large specimen (R. = 50 mm.) the papular areas are, as usual, arranged in six regular rows. They are small and deeply sunken between the prominent rows of abactinal plates. The papular pores number from 1–9. The areas containing the greatest number of pores are situated near the base of the ray and on the disc. Smaller specimens possess from 1–4 and 1–6 pores to an area. The papular areas situated on either side of the median series of plates do not reach the tip of the ray, and therefore only four series of areas can be counted in that region. This character can also be observed in juvenile examples. It was also described by Clark (1921) for *T. lithosora*.

The abactinal plates are noticeably elevated, even in young examples. The plates on the disc are the largest to be found. All abactinal and superomarginal plates are clothed by densely packed granules, among which here and there occur larger and more conspicuous granules of a smooth and bald nature. These larger granules occur in the centre of the plate. They number from 2 to 15 to a plate, and are similar to those described by Clark as occurring in *T. lithosora*. The granules between the papular pores are very uneven in size.



Text-fig. 1.—*Tamaria fusca*, Gray. Pedicellaria drawn from Gray's type specimen.

The terminal plate is hemispherical and smooth.

The madreporite is elevated and prominent.

The pedicellariae are particularly prominent and plentiful in juvenile examples of the species.

The inferomarginal plates, although densely clothed in small granules, are destitute of the large and bald granules characteristic of the superomarginal and abactinal plates, and bear instead, in almost every case, a central blunt spine or tubercle.

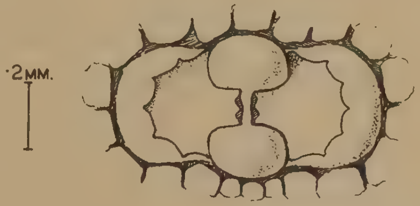
Two series of actinolateral plates occur.

The furrow spines number two to a plate. No granules occur between these spines. Behind the furrow series is a single series of prominent ovoidal spine-like granules, which are spaced much closer together in the region of the mouth than anywhere else.

Material Examined.—Eight specimens. Six juveniles with R. ranging from 7 mm. to 17 mm. (Brit. Exp. Coll.); one apparently half-grown specimen, R. = 30·5 mm., and one seemingly fully grown adult, R. = 50 mm. (Austr. Mus. Coll.); this latter specimen was figured by me in a previous paper (1930).

Colour.—Only the largest specimen shows the brown and "Bougainvillea" purple markings. The other examples have been preserved in alcohol and have lost all their natural colours.

AFFINITIES.—The only species to which *fusca* can now be regarded as closely related is *T. lithosora*, H. L. Clark. Judging from Clark's description and figures (1921), I was at first inclined to place *lithosora* into the synonymy of *fusca*, but before doing so more information was sought from Clark. Being unable to send me his type for examination Clark kindly supplied the following information (*in litt.*): "With regard to my species *lithosora*, I have just compared the type with Fisher's figures of *fusca* and the difference between them is very marked . . . in *lithosora* the tubercles are very rounded and smooth and not in the least like tubercles or small spinelets such as one sees in *fusca*. I might add that in *lithosora* on the oral surface there is a very complete series of subambulacral spines, which give the furrow a very different appearance from what I have seen either in specimens or figures of *fusca*." Clark admits, however, the possibility of his *lithosora* being only an extreme form of *fusca*, but until his specimen is examined more critically and compared with authentic material of *fusca*, one cannot arrive at a very definite and satisfactory conclusion.



TEXT-FIG. 2.—*Tamaria megaloplax* (Bell). Pedicellaria drawn from Bell's specimen of *Linckia megaloplax* from Albany Island; Alert Expedition.

Tamaria megaloplax (Bell).

(Plate IX, figs. 1—3; Plate XII, figs. 8, 12, 14.)

Linckia megaloplax, Bell, Rep. Zool. Coll. "Alert," 1884, p. 126 (Albany Island specimen).
Ophidiaster tuberifer, Sladen, "Challenger" Zool. XXX, 1889, p. 404, pl. lxv, figs. 1–4; Döderlein (in Semon), Zool. Forschungsreisen in Aust. V, 1896, p. 317; Koehler, Echinod. Ind. Mus. VI, Asteroidea, 2 (Shallow Water Asteroidea) 1910, p. 148; Fisher, Bull. U.S. Nat. Mus. 100, 1919, p. 393.
Tamaria tuberifera, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 90, pl. viii, fig. 1; Livingstone, Rec. Aust. Mus. XVIII, No. 1, 1930, p. 22, pl. iv, fig. 3; pl. viii, figs. 1, 3, 4.

LOCALITY.—Station XXII, 11.iii.1929. To East of Snake Reef, 13½ fathoms, mud with forams and shells (1).

DISTRIBUTION.—Coast of Queensland, Torres Strait, Andaman Islands and Philippines.

A set of photographs of Bell's original Albany Island specimen ("Alert" Coll.) of *Linckia megaloplax* is before me. There is no doubt that Sladen's *Ophidiaster tuberifer* is the same species. It is most unfortunate that such a well-known name as *tuberifer* should be sunk as a synonym in favour of Bell's hitherto somewhat uncertain name, but as Bell's species has priority, there is no alternative. Specimens from Fitzroy Island, Port Curtis and Port Denison, Queensland, were also included by Bell under his original description of *megaloplax*, but only the specimen from Albany Island can be regarded as authentic at present. These remaining specimens may or may not belong to one species—the uncertainty arising from the apparent laxity with which Bell appended names.

Bell's description certainly fits the photographs of the Albany Island specimen, and I see no reason for designating any other specimen from the mixed batch he had before him as the type of Bell's species. Other specimens erroneously named *megaloplax* by Bell (Holothuria Bank material referred to by Clark, 1921) do not belong here, and have been dealt with later under separate headings.

It is interesting to be able to confirm Clark's surmise (1921, p. 90) that *T. tuberifera*, Sladen, is really Bell's Albany Island *megaloplax*.

Only one specimen of the species is in the expedition's collection, R. = 31·5 mm.

Tamaria hirsuta (Koehler).

(Plate X, figs. 5—7; Plate XI, figs. 9 and 10; Plate XII, fig. 20.)

Ophidiaster hirsutus, Koehler, Echinod. Ind. Mus. VI, Asteroidea, 2 (Shallow Water Asteroidea), 1910, p. 149, pl. xviii, figs. 5, 6; Fisher, Bull. U.S. Nat. Mus. 100, 1919, p. 388.

Tamaria fusca, H. L. Clark (*non* Gray), "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 89 (part), pl. xxviii, figs. 1, 2.

DISTRIBUTION.—Andaman Islands and Holothuria Bank off north-west Australia.

I have before me on loan one of the specimens from Holothuria Bank identified by Bell as his *megaloplax* and referred to by Clark (*loc. cit.*) as Koehler's *hirsutus*. In the first place I am reasonably confident that Bell's identification was incorrect, and that the Holothuria Bank specimens are not conspecific with Bell's *megaloplax* from Albany Island. Secondly, I venture to disagree with both Fisher and Clark as to the status of *hirsuta*. In differing from the more mature opinion of these authorities I submit that the photographs of *hirsuta* and *fusca* in this work are of specimens of distinct species.

T. hirsuta seems to be closer to *megaloplax* than to *fusca*, but here also there are differences, and I prefer to await more evidence before dropping the specific name, *hirsuta*. Lastly, greater reliance should be placed on Koehler's judgment, as he was doubtless aware of the existence of *fusca*, *tuberifera* and *megaloplax*, even though they were then only imperfectly known; and he would presumably have taken them into consideration before establishing a new species for his specimen. In any case the specimens and photographs before me seem to justify Koehler's action. I include under these species Studer's "Gazelle" specimens, one of which was referred to by Clark (1921) as *T. fusca*. Clark's specimen is before me on loan, and I am confident it should not be attributed to *T. fusca*. One other specimen, in the collection of the Australian Museum, also belongs here. It has R. = 26 mm., and is accompanied by a label bearing the locality "Western Australia." It is identical with Studer's specimen before me. In conclusion it may be pointed out that the species of *Tamaria* from the north and north-west coasts of Australia have, so far as is known, no representatives on the Queensland coast, and conversely; therefore no overlapping of species is believed to occur.

Tamaria ornata (Koehler).

(Plate XII, fig. 2.)

Ophidiaster ornatus, Koehler, Echinod. Ind. Mus. VI, Asteroidea, 2 (Shallow Water Asteroidea), 1910, p. 151, pl. xviii, figs. 3, 4

Tamaria fusca, H. L. Clark (*non* Gray), "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 89 (part).

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DISTRIBUTION.—S. coast Ceylon and Holothuria Bank off north-west Australia.

I have before me a second specimen from Holothuria Bank (R. = 22 mm.) labelled by Bell as his *megaloplax* and considered by Clark closely to resemble the type of Koehler's *ornatus*. Clark, through whom the present specimen was secured on loan, considered it referable to *fusca*, and reduced *ornatus* to the synonymy of that species. The specimen, however, shows characters which serve instantly to separate it from *fusca*, and as it cannot be reasonably referred to any other species of the genus, one must regard it as representing a distinct species.

Tamaria sp.

(Plate XI, figs. 5, 6, 11, 12; Plate XII, figs. 3, 9, 13.)

LOCALITIES.—12 fathoms, Fitzroy Island, Queensland (smallest specimen); Port Curtis, Queensland, 12 fathoms (Austr. Mus. specimens).

In order to review all the material available to me, I have included under this heading three further specimens in the collections of the Australian Museum. The smallest specimen has R. = 29 mm., and is from 12 fathoms off Fitzroy Island, Queensland. This is one of Bell's localities for some of the examples of *megaloplax* gathered by the "Alert," but I have no reason to believe that the present specimen was secured by that expedition. A slightly larger specimen, R. = 34 mm., was collected recently in Port Curtis, Queensland, in a depth of 12 fathoms together with a further specimen, the largest of the three, with R. = 103·5 mm. Port Curtis is another of the localities of *megaloplax* given by Bell in his "Alert" report. All three specimens seem to be closely related and possibly referable to the one species. They are most certainly not referable to Bell's *megaloplax*, as they might be in view of the localities from which they came. Either of the two smallest specimens at first sight might be taken for the young of *megaloplax*, but comparison shows that *megaloplax*, even in the young stage, possesses definite roundly rectangular and large papular areas which are not deeply sunken, whereas the two small Tamarias under discussion have very small and sunken papular areas. The papular areas themselves furnish a very reliable means of distinguishing species of the genus.

The largest specimen is by far the most interesting, as it seems to alter one's views in regard to the status of the genus *Tamaria*. It has been compared with examples of *Hacelia helicosticha*, Sladen, to which it appears to be closely related.

The salient feature regarded as distinguishing *Tamaria* from *Ophidiaster* is the number of rows of papular areas, yet it is known that the former genus approaches the latter in the occasional presence of isolated papulae on the actinal surface immediately below the inferomarginals. Although these additional papulae have been considered by H. L. Clark to be unimportant as generic characters, their presence in greater numbers than ever known before raises the question of their differential value and of the limits of the two genera. The large specimen before me appears to possess characters intermediate between those of *Ophidiaster* and *Tamaria*. It cannot be referred to any of the known species of *Tamaria*, and, indeed, it is uncertain whether it belongs to the genus, although I have provisionally placed it there. On the other hand, if it were not for the unusually large number of papular pores below the inferomarginals the specimen could be regarded as agreeing in many respects with *T. scleroderma*. There are, however, important characters other than the papular areas which instantly separate the latter species from that represented by my specimen. The general form of the body and rays alone are sufficient.

The two smaller specimens possess only six series of papular areas. The larger of the two is the more likely to be the young of the largest specimen. The extra series of papular areas obviously becomes manifest with age. Pedicellariae occur on the three specimens. and resemble those found on *T. megaloplax*.

All three have been figured in detail in order to assist future workers on this difficult group.

Nepanthia (? *brevis*) (Perrier).

(Plate V, figs. 8 and 9.)

Asterina (*Nepanthia*) *brevis*, Perrier, Arch. Zool. Exp. Gén. V, 1876, p. 241.

Nepanthia brevis, Sladen, " Challenger " Zool. XXX, 1889, p. 387, pl. lxiii, figs. 3–5 ; H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 95, pl. vi, figs. 3, 4.

LOCALITY.—Dredged 8 fathoms N.E. of Low Isles, mud and stones, September, 1928 (1).

DISTRIBUTION.—Torres Strait and North-west Australia (Philippines and N. Queensland doubtful).

I refer with some hesitation this single specimen to the above species. Several species of the genus, including *brevis*, are ill defined, and their descriptions confusing. Fisher (1919) had difficulty in deciding whether one of his specimens belonged to *joubini*, Koehler, or whether it was a six-rayed example of *brevis*. The specimen before me resembles that of Fisher and I find a similar difficulty in its attribution.

The Australian Museum specimens of the genus are at present on loan to H. L. Clark, who intends to make a detailed study of them in conjunction with other material and to publish the results of his work. Without this material I am unable to make comparisons with the present specimen, but to avoid confusion as to its nature two illustrations of it are given.

The specimen possesses five madreporites. R. = 34 mm., r. = 10 mm., rays curled.

Patiriella exigua (Lamarck).

Asterias exigua, Lamarck, Anim. s. Vert. II, 1816, p. 554.

Patiriella exigua, Verrill, Amer. J. Sci. XXXV, 1913, p. 484.

Asterina exigua, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol Carn. Instn. X, 1921, p. 97, pl. vii, figs. 6, 7 (and synonymy).

Patiriella exigua, H. L. Clark, Rec. S. Aust. Mus. III, 1928, p. 392.

LOCALITY.—Low Isles (10) (almost general in occurrence) ; Snapper Island, N. of Low Isles. Specimens were taken from under coral boulders and stones between tidemarks (10). Gen. Survey, Inner Ramparts, 20.iii.1929 ; Tripneustes Spit, 21.iii.1929 ; Asterina Spit, 20.iii.1929 ; Region F.9, 4.iv.1929 ; Three Isles, 5.v.1929.

DISTRIBUTION.—Madagascar, Cape of Good Hope, Mauritius, Andaman and Nicobar Islands, Java, Moluccas, Philippines, South, East and North Australia.

Clark (*loc. cit.*) has recorded that this sea-star is abundant at Erub, and it is also common at the above localities.

The largest specimen has a diameter of 29 mm., but in the majority this measurement is between 18 and 25 mm. Ten specimens were collected in each of the localities given above, and all are five-rayed, except one which possesses six rays.

Echinaster luzonicus (Gray).

Othilia luzonica, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 282.
Echinaster luzonicus, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 98, pl. x, figs. 2–4 (and synonymy).

Localities.—Gen. Survey, 24.iv.1929 (4). Upper platform of Luana Reef. Taken also by members of the Australian Museum Staff in the vicinity of the Western and Middle Moats. Station XVII, 9.iii.1929, about quarter-mile N. of North Direction Island, 19 fathoms, sand and thick Halimeda (1); Station XIX, 10.iii.1929 about half-mile N. of Eagle Island, 10 fathoms, shell gravel, rich Halimeda (2).

Distribution.—New Ireland, Queensland, New Caledonia, Amboina, Admiralty Islands, Ceylon, Philippines, New Britain, Northwest Australia and Torres Strait.

Four specimens were collected from under dead coral boulders on the weedy sand flat at Low Isles and seven secured from deeper water. The diversity in the number of rays is clearly illustrated on the specimens before me; of the shore forms the largest has five rays, two have six, and one seven. All tolerably complete specimens have two madreporites each. In life, all were of a more or less dark or blackish hue, but when dried, after preservation in alcohol, the colour varied considerably, as is usual in the species. Two are of a rusty red hue, with darker irregular blotches, while another is an ashen colour with dark sepia patches. The fourth is dark greenish yellow on the abactinal surface, and noticeably paler on the actinal surface. The adambulacral plates bear a distinct subambulacral spinelet near the margin of the furrow.

Metrodira subulata, Gray.

(Plate VIII, figs. 1 and 4.)

Metrodira subulata, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 282; Fisher, Bull. U.S. Nat. Mus. 100, III, 1919, p. 406 (and synonymy); H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 100.

Localities.—Station XII, 24.ii.1929. Penguin Channel, 10–15½ fathoms, rock and shell gravel, mud on edges of pit (1). Station XXII, 11.iii.1929. To E. of Snake Reef, 13½ fathoms, mud, forams, shells (1).

Distribution.—Macclesfield Bank; Philippine Islands, Torres Strait, Aru, Amboina, N.W. Australia; N.E. Australia; George Sound, New Zealand; Bay of Bengal; Ceylon (*fide* Fisher, *loc. cit.*). In regard to the New Zealand record of the species, on the authority of Sladen, followed by Fisher, Mortensen* states that it may be regarded as fairly certain that *M. subulata* does not occur in New Zealand waters, and that the record was evidently based upon " unreliable Museum labels."

Clark (*loc. cit.*) doubts the accuracy of Bell's " Alert " identification. The present record, however, proves that the species extends down the coast of Queensland *via* the Great Barrier Reef from Torres Strait.

Specimens Examined.—Two five-rayed examples, R. = 60 mm., r. = 7·5 mm.; R. = 35 mm., r. = 3·5 mm.

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* Papers from " Dr. Mortensen's Pacific Expedition, 1914–16, XXIX, Ech. New Zeal. and the Auckland-Campbell Islands," Vidensk. Medd. naturh. Foren. Kjöb. Bd. LXXIX, 1925, p. 263.

Acanthaster planci (Linnaeus).

Asterias planci, Linnaeus, Syst. Nat. ed. X, 1758, p. 823.
Acanthaster planci, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 101.

Locality.—Low Isles, reef, 20.vii.1929 (1).

Distribution.—Zanzibar, Arabian Gulf and Red Sea across to Society and Hawaiian Islands, including Philippines and Riu-kiu Islands, Moluccas, Fiji, Samoan Islands, Mauritius, Torres Strait and Queensland.

A single specimen, measuring 202 mm. across, is referable to this species.

Retaster insignis, Sladen.

Retaster insignis, Sladen, J. Linn. Soc. Zool. XVI, 1882, p. 200; Sladen, " Challenger " Zool. XXX, 1889, p. 482, pl. lxxvi, figs. 3, 4; pl. lxxvii, figs. 11, 12; Fisher, Bull. U.S. Nat. Mus. 100, III, 1919, p. 460; H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 103.

Localities.—Station XVII, 9.iii.1929. About ¼ mile N. of North Direction Island, 19 fathoms, sand, thick Halimeda weed (2). Station XVI, 9.iii.1929. About ½ mile W. of North Direction Island, 20 fathoms, stony (1).

Distribution.—Philippines; Amboina; Banda Sea; Arafura Sea; Torres Strait and Thursday Island; Samoa; Port Molle, Queensland and probably Port Jackson, New South Wales.

Three specimens: R. = 46 mm.; R. = 23·5 mm.; R. = 15·5 mm. According to the label the largest animal was in life dark red on a grey background.

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DESCRIPTION OF PLATE I.

Fig. 1.—*Stellaster princeps*, Sladen. Specimen from Western Australia (Austr. Mus Coll.) (R. = 128 mm.). Abactinal view. (Slightly under half nat. size.)

Fig. 2.—*Stellaster princeps*, Sladen. Actinal view of above specimen. (Slightly under half nat. size.)

Fig. 3.—*Stellaster equestris* (Retzius). Specimen from Nagasaki, Japan (Austr. Mus. Coll.) (R. = 58 mm.). Actinal view. (About nat. size.)

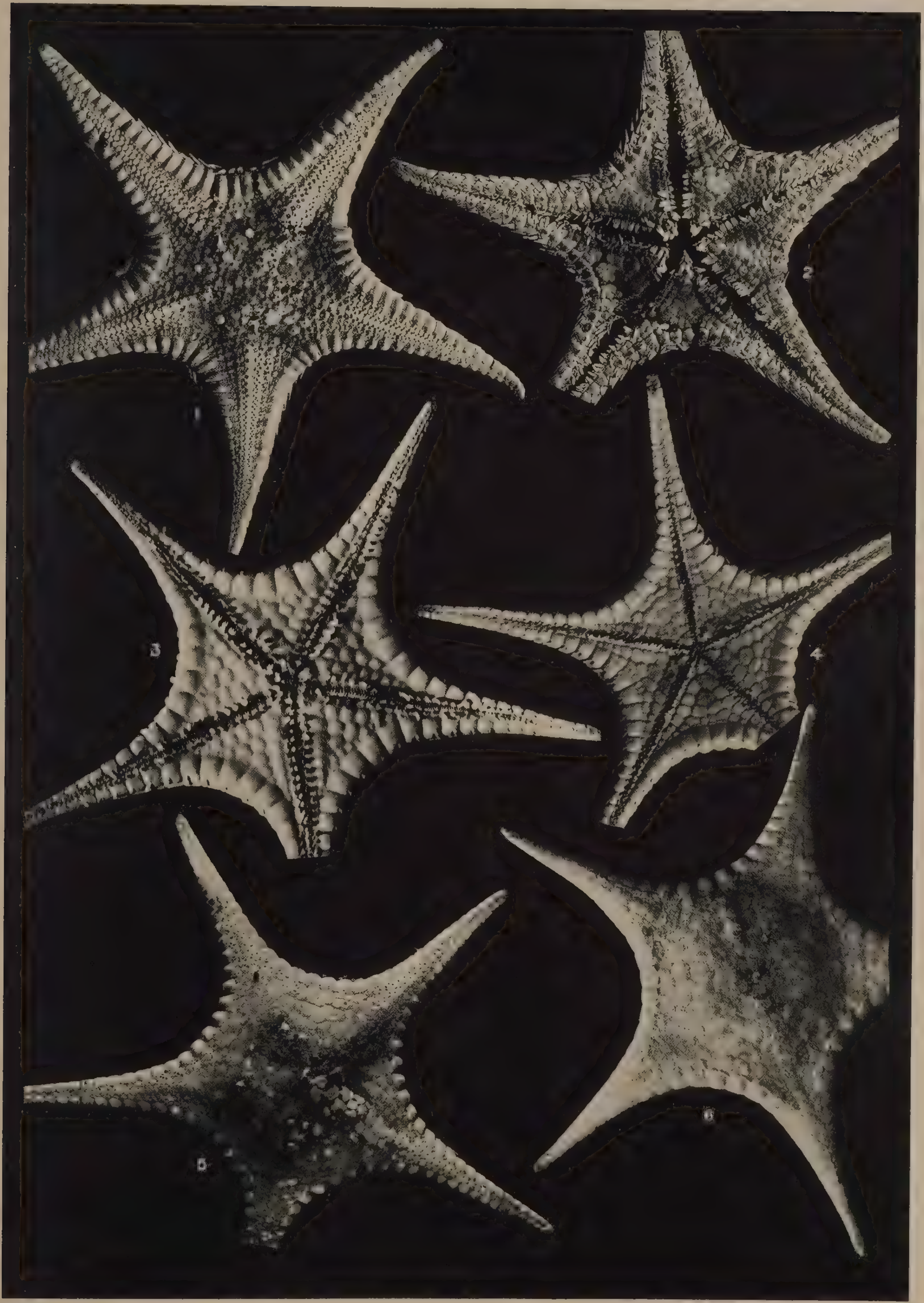
Fig. 4.—*Stellaster incei*, Gray. Specimen from Albany Passage, North Queensland (Austr. Mus. Coll.) (R. = 59 mm.). Actinal view. (Slightly under nat. size.)

Fig. 5.—*Stellaster incei*, Gray. Abactinal view of the above specimen (R. = 59 mm.). (Slightly under nat. size.)

Fig. 6.—*Stellaster equestris* (Retzius). Abactinal view of above specimen from Nagasaki, Japan (Austr. Mus. Coll.). (Slightly under nat. size.)

GREAT BARRIER REEF EXPEDITION 1928–29.

Brit. Mus. (Nat. Hist.). REPORTS, VOL. IV, No. 8. PLATE I.



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DESCRIPTION OF PLATE II.

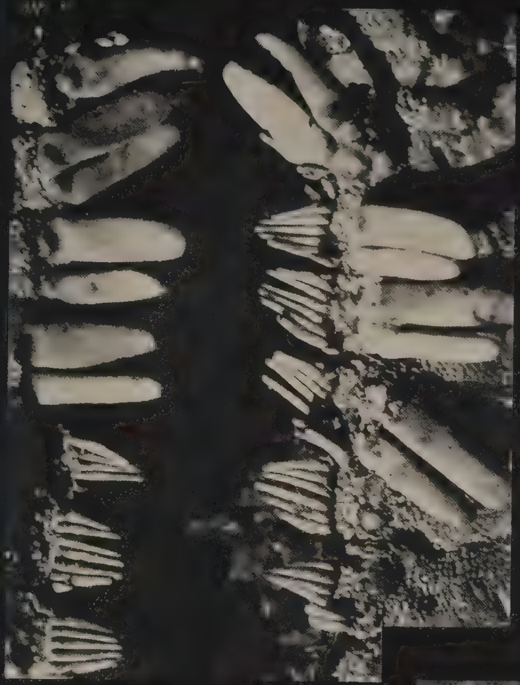
FIG. 1.—*Stellaster princeps*, Sladen. Specimen from Western Australia (R. = 128 mm.). Ambulacral furrow. (× 5.)

FIG. 2.—*Stellaster incei*, Gray. Specimen from Western Australia (R. = 69 mm.). Ambulacral furrow. (× 5.)

FIG. 3.—*Stellaster equestris* (Retzius). Specimen from Nagasaki, Japan (R. = 58 mm.). Ambulacral furrow. (× 5.)

FIG. 4.—*Stellaster incei*, Gray. Specimen from Albany Passage, North Queensland (R. = 59 mm.). Ambulacral furrow. (× 5.)

FIG. 5.—*Stellaster incei*, Gray. Specimen from Low Isles, North Queensland (R. = 82 mm.). Ambulacral furrow. (× 5.)



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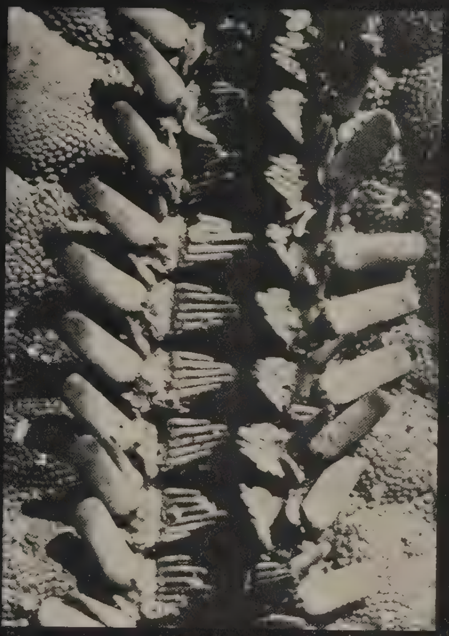

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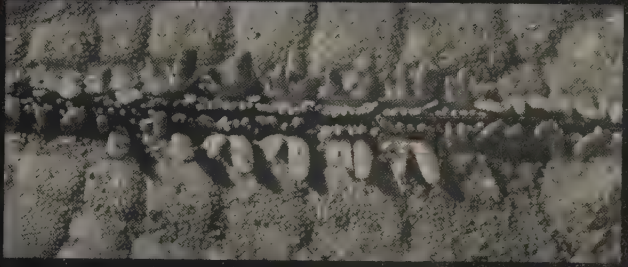

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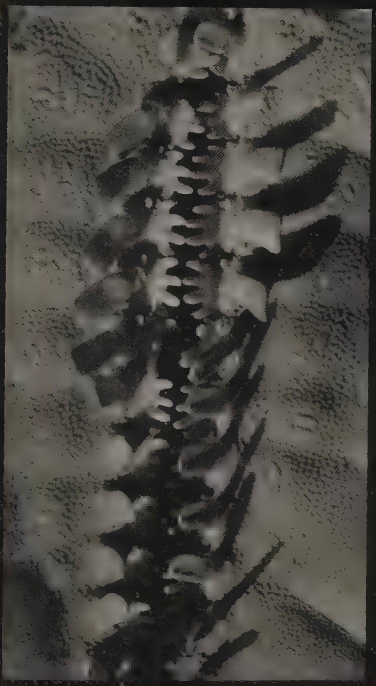

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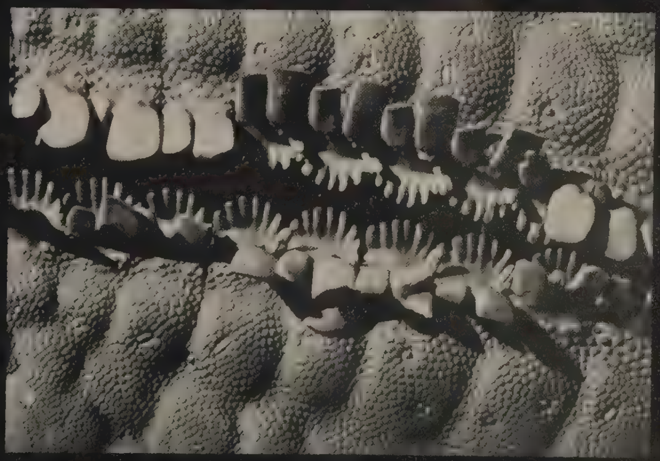

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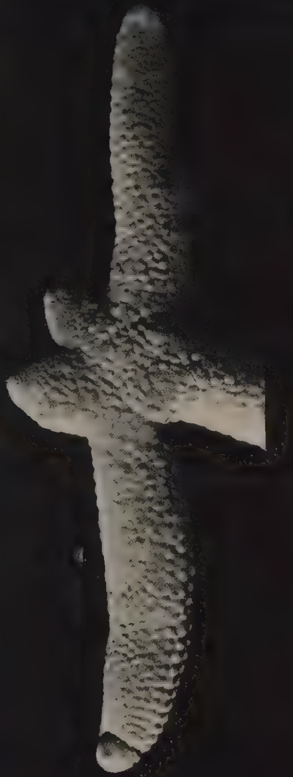
DESCRIPTION OF PLATE III.

Fig. 1.—*Linckia laevigata* (Linnaeus). Specimen from Low Isles. Abactinal view. (Slightly over nat. size.)

Fig. 2.—*Culcita novaeguineae* (M. and Tr.). Half-grown specimen from Low Isles, showing the five "humps" described in text. The continuous poriferous areas are more conspicuous near the margins. (About two-thirds nat. size.)

Fig. 3.—*Nardoa pauciforis* (v. Mart.). Specimen from Low Isles. Abactinal view. (Slightly over half nat. size.)

Fig. 4.—*Culcita novaeguineae* (M. and Tr.). Ambulacral furrow of juvenile specimen from Low Isles. (× 5.)



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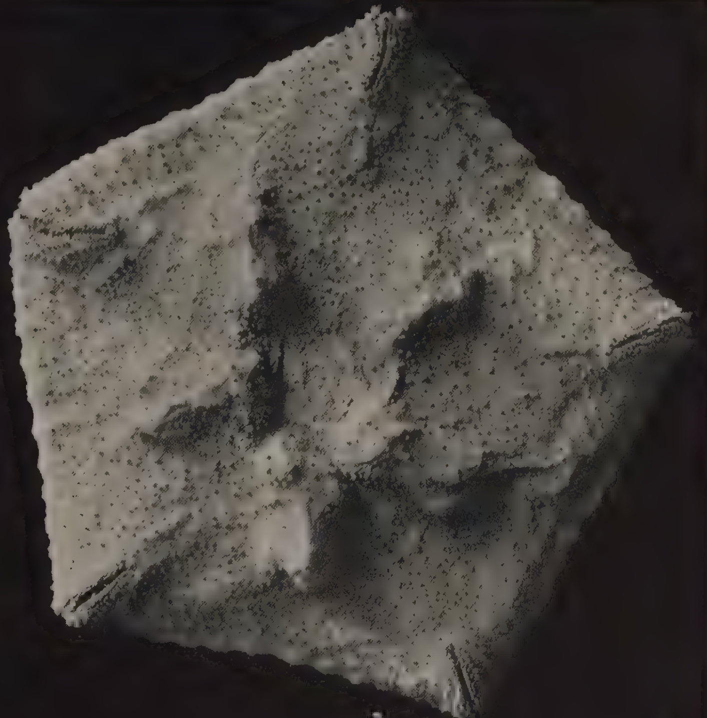

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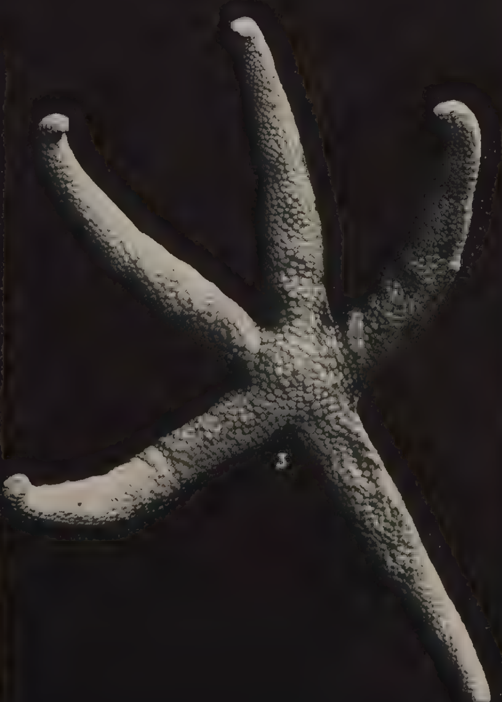

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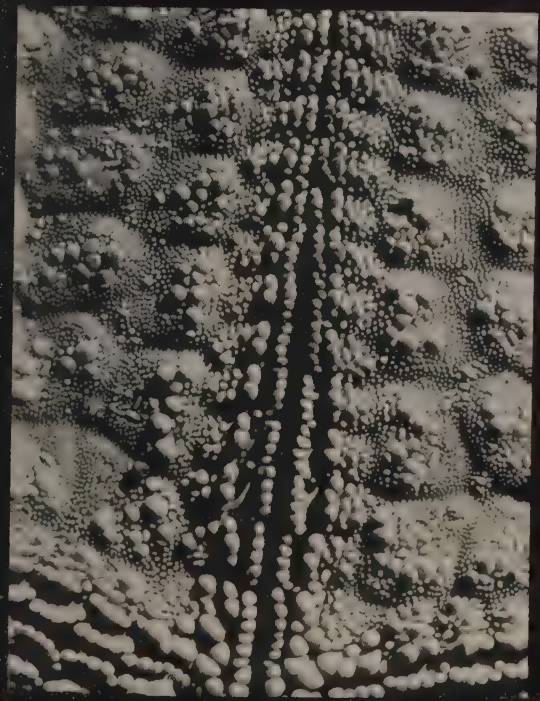

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DESCRIPTION OF PLATE IV.

Fig. 1.—*Nardoa novaecaledoniae* (Perrier). Specimen from Low Isles. Ambulacral furrow. (× 5.)

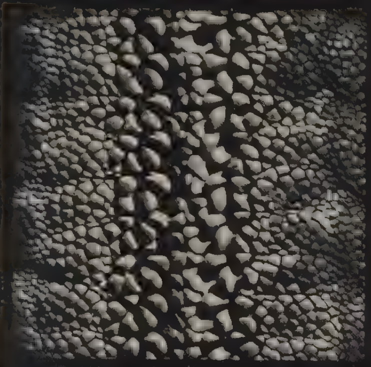
Fig. 2.—*Linckia laevigata* (Linnaeus). Specimen from Low Isles (R. = 157 mm.). Showing granules between the furrow spinelets. (× 5.)

Fig. 3.—*Culcita novaeguineae* (M. and Tr.). Portion of actinal surface of half-grown specimen from Low Isles. (× 5.)

Fig. 4.—*Culcita novaeguineae* (M. and Tr.). Same specimen as above showing ambulacral furrow. (× 5.)

Fig. 5.—*Linckia laevigata* (Linnaeus). Specimen from Low Isles (R. = 157 mm.). Dissection showing furrow spinelets separated by granules. (× 8.)

Fig. 6.—*Nardoa pauciforis* (v. Mart.). Specimen from Low Isles. Ambulacral furrow. (× 5.)



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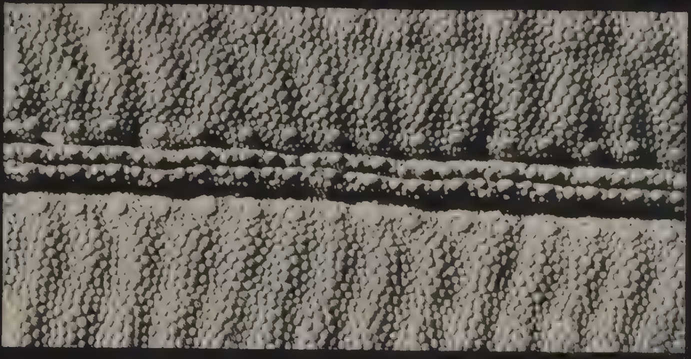

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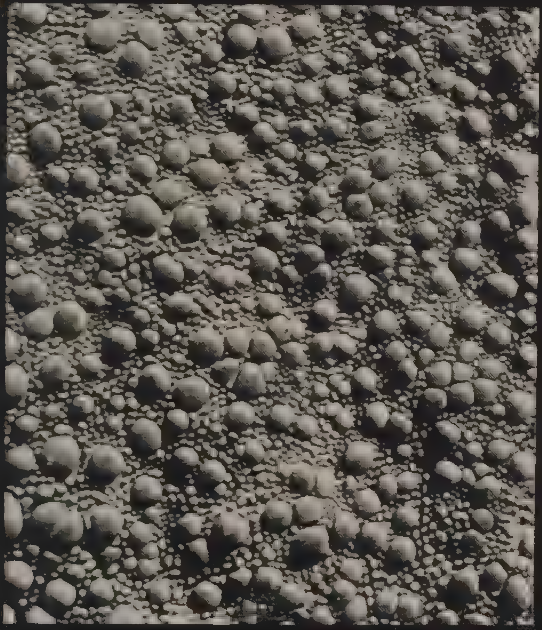

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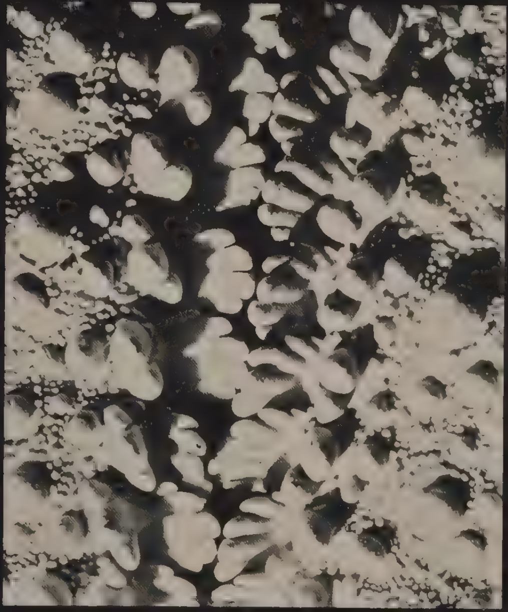

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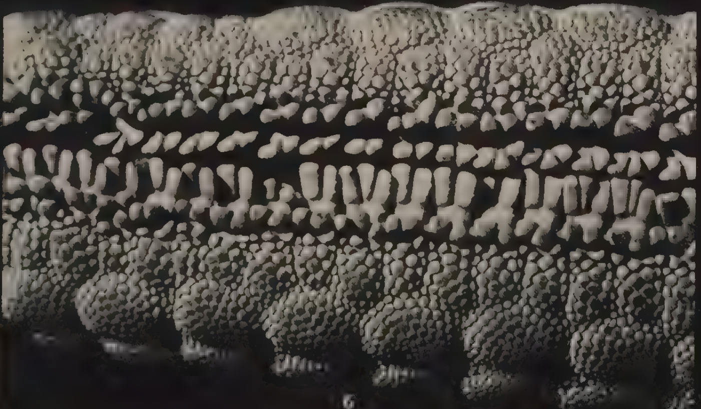

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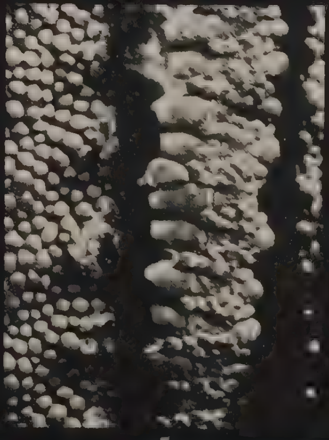

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DESCRIPTION OF PLATE V.

FIG. 1.—*Tosia queenslandensis*, sp. nov. Holotype (R. = 17 mm.). Abactinal view. (Slightly under × 2.)

FIG. 2.—*Tosia queenslandensis*, sp. nov. Actinal view of holotype. (Slightly under × 2.)

FIG. 3.—*Nardoa novaecaledoniae* (Perrier). Four-rayed example from Low Isles. (Slightly over half nat. size.)

FIG. 4.—*Anthenea tuberculosa*, Gray. R. = 22 mm. Actinal view. (About 1½ times nat. size.)

FIG. 5.—*Anthenea tuberculosa*, Gray. Abactinal view of same specimen. (About 1½ times nat. size.)

FIG. 6.—*Anthenea tuberculosa*, Gray. R. = 16 mm. Abactinal view. (Slightly over 1½ times nat. size.)

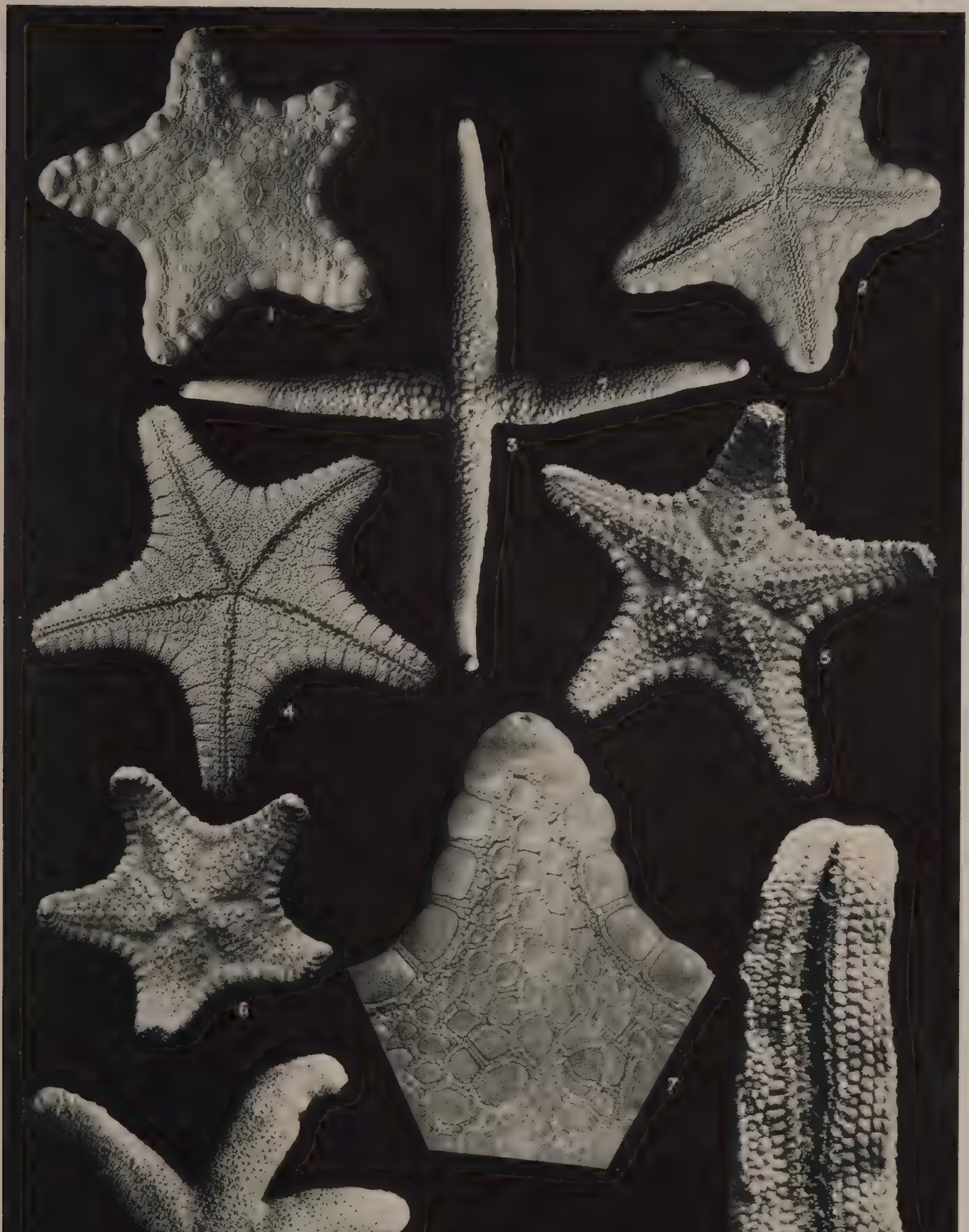
FIG. 7.—*Tosia queenslandensis*, sp. nov. Portion of abactinal surface of holotype. (Slightly over × 4.)

FIG. 8.—*Nepanthia* (? *brevis*, Perrier). R. = 34 mm. Ambulacral furrow. (Slightly over × 3.)

FIG. 9.—*Nepanthia* (? *brevis*, Perrier). Abactinal view of above specimen. (Slightly over nat. size.)

GREAT BARRIER REEF EXPEDITION 1928–29.

Brit. Mus. (*Nat. Hist.*). REPORTS, VOL. IV, No. 8. PLATE V.



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DESCRIPTION OF PLATE VI.

Fig. 1.—*Oreaster australis*, Lütken. Actinal view of smallest juvenile specimen (R. = 20 mm.). (Nearly × 2.)

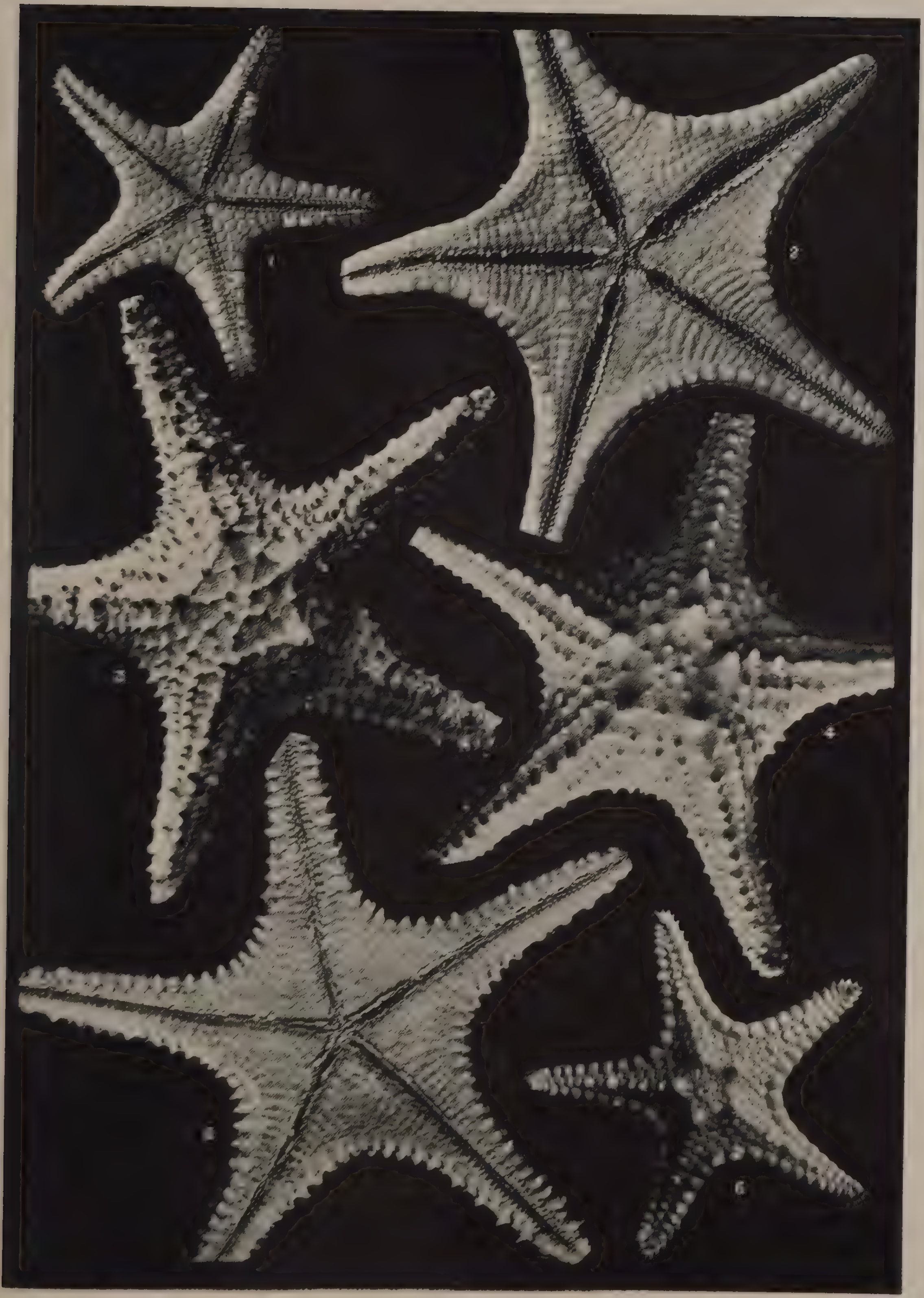
Fig. 2.—*Oreaster australis*, Lütken. Actinal view of smallest adult specimen (R. = 78 mm.). (Slightly under nat. size.)

Fig. 3.—*Oreaster alveolatus* (Perrier). Abactinal view of one of three specimens in the collections of the Australian Museum from New Caledonia (R. = 90 mm.). (About two-thirds nat. size.)

Fig. 4.—*Oreaster australis*, Lütken. Abactinal view of largest young adult (R. = 91 mm.). (Slightly over two-thirds nat. size.)

Fig. 5.—*Oreaster alveolatus* (Perrier). Actinal view of above specimen (fig. 3) (R. = 90 mm.). (Slightly over two-thirds nat. size.)

Fig. 6.—*Oreaster australis*, Lütken. Abactinal view of smallest juvenile specimen. Same specimen as fig. 1. (Nearly twice nat. size.)



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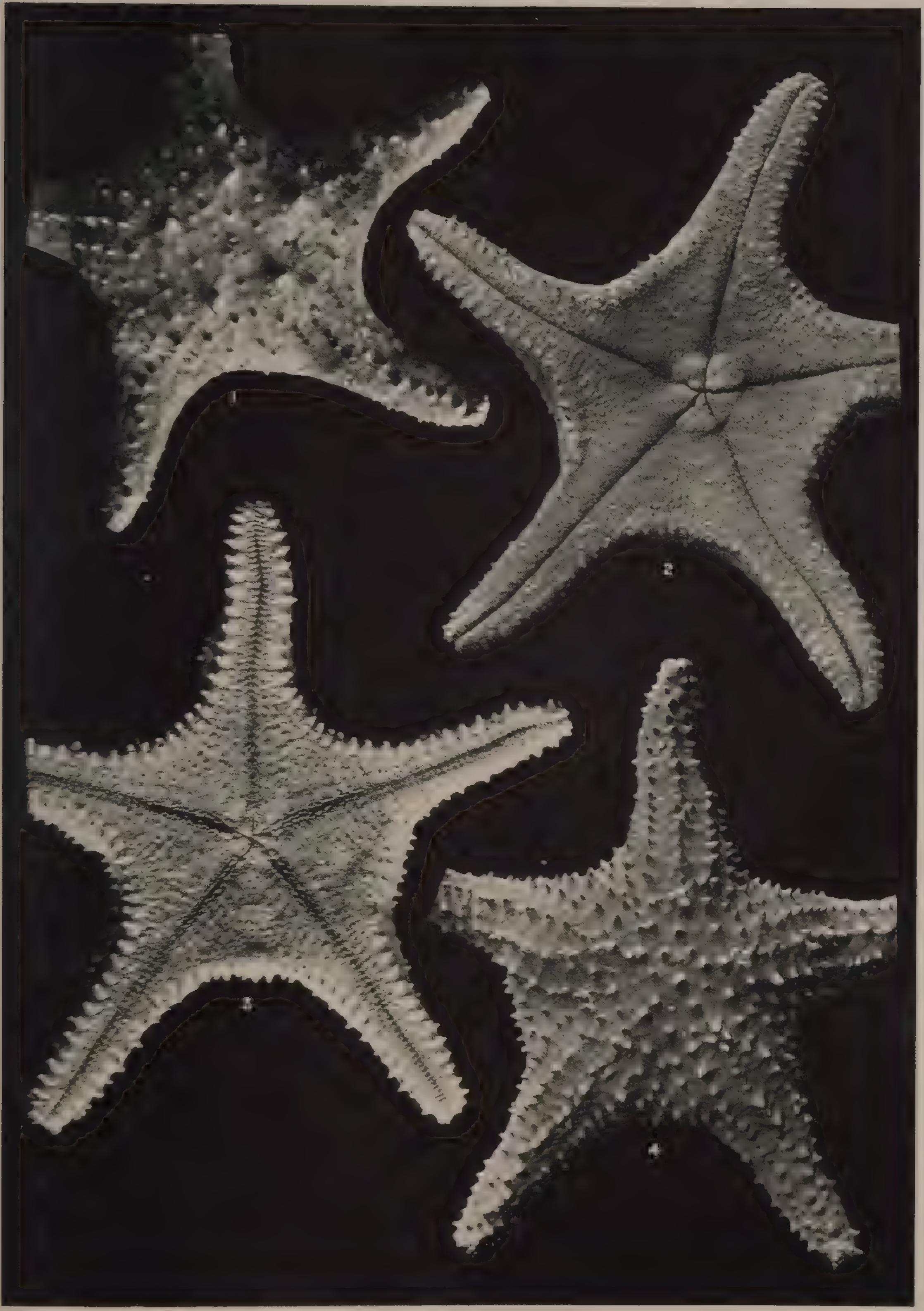
DESCRIPTION OF PLATE VII.

FIG. 1.—*Oreaster australis*, Lütken. Abactinal view of specimen from 18 miles S.W. by S. of Lady Elliot Island, Queensland. Collected by F.I.S. "Endeavour" and identified by Dr. H. L. Clark (Austr. Mus. Coll.) (R. = 120 mm.). (× 2.)

FIG. 2.—*Oreaster australis*, Lütken. Actinal view of above specimen (R. = 120 mm.). (× 2.)

FIG. 3.—*Oreaster australis*, Lütken. Actinal view of another specimen collected by the "Endeavour" in the same locality as the above specimen and identified by Dr. H. L. Clark (Austr. Mus. Coll.) (R. = 125 mm.). (× 2.)

FIG. 4.—*Oreaster australis*, Lütken. Abactinal view of above specimen (R. = 125 mm.). (× 2.)



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DESCRIPTION OF PLATE VIII.

Fig. 1.—*Metrodira subulata*, Gray. R. = 35 mm. Actinal view. (× 4.)

Fig. 2.—*Astropecten granulatus*, M. and Tr. R. = 38 mm. Abactinal view. (Slightly over half nat. size.)

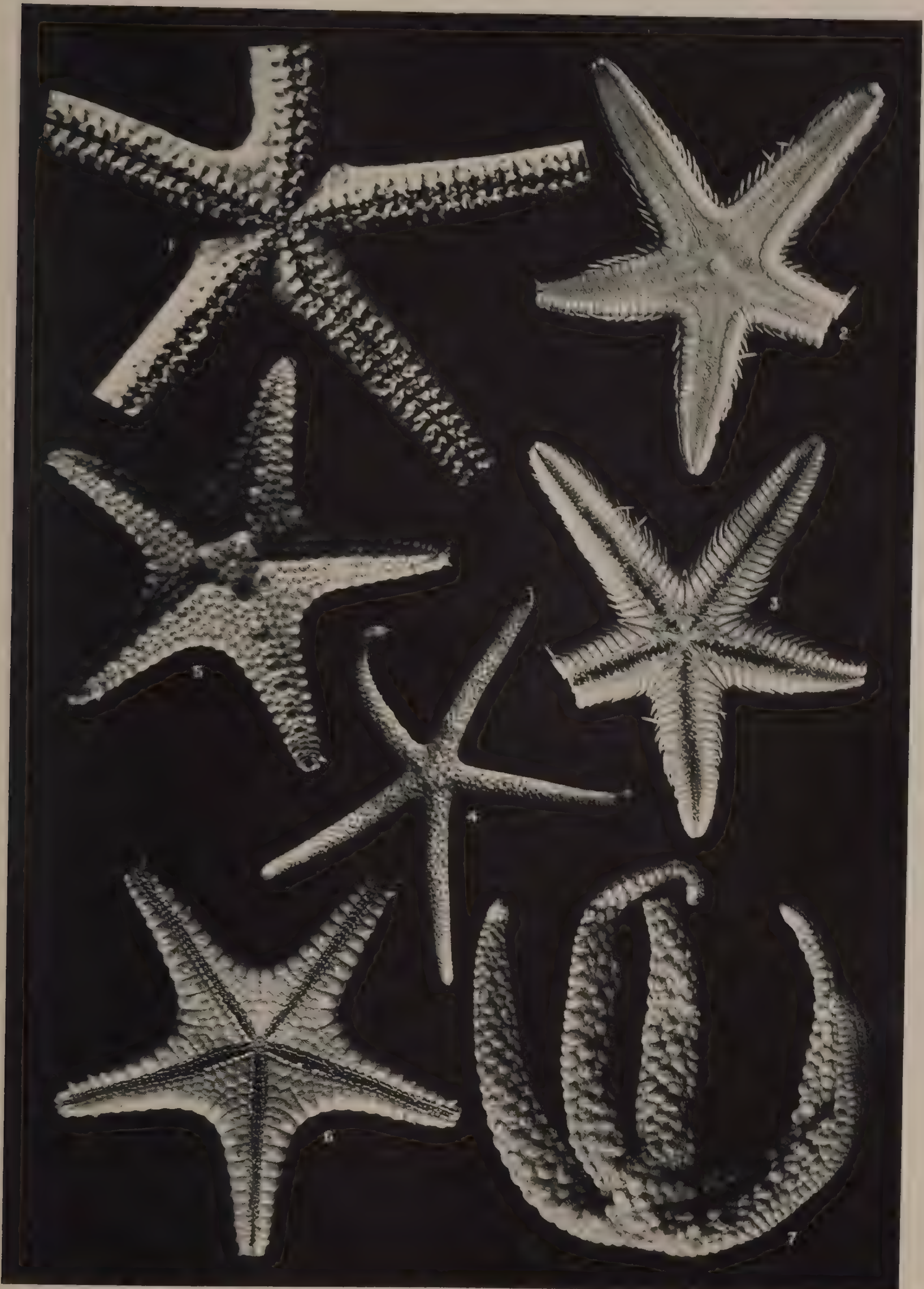
Fig. 3.—*Astropecten granulatus*, M. and Tr. Actinal view of above specimen. (Slightly over half nat. size.)

Fig. 4.—*Metrodira subulata*, Gray. Abactinal view (R. = 35 mm.). (Slightly over nat. size.)

Fig. 5.—*Oreaster australis*, Lütken. Abactinal view of largest juvenile specimen (R. = 33·5 mm.). (Slightly over nat. size.)

Fig. 6.—*Oreaster australis*, Lütken. Actinal view of above specimen (R. = 33·5 mm.). (Slightly over nat. size.)

Fig. 7.—*Nardoa rosea*, H. L. Clark. Abactinal view. Alternating large and small superomarginals seen best on second ray from left (R. = 72 mm.). (About nat. size.)



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DESCRIPTION OF PLATE IX.

FIG. 1.—*Tamaria megaloplax* (Bell). Portion of abactinal surface of ray of Bell's Albany Island specimen collected by the "Alert." Specimen now regarded as holotype (Brit. Mus. Coll.). (× 4.)

FIG. 2.—*Tamaria megaloplax* (Bell). Portion of actinal surface of ray of holotype. (× 4.)

FIG. 3.—*Tamaria megaloplax* (Bell). Actinal view of Bell's Albany Island specimen, the holotype. (Nat. size.)

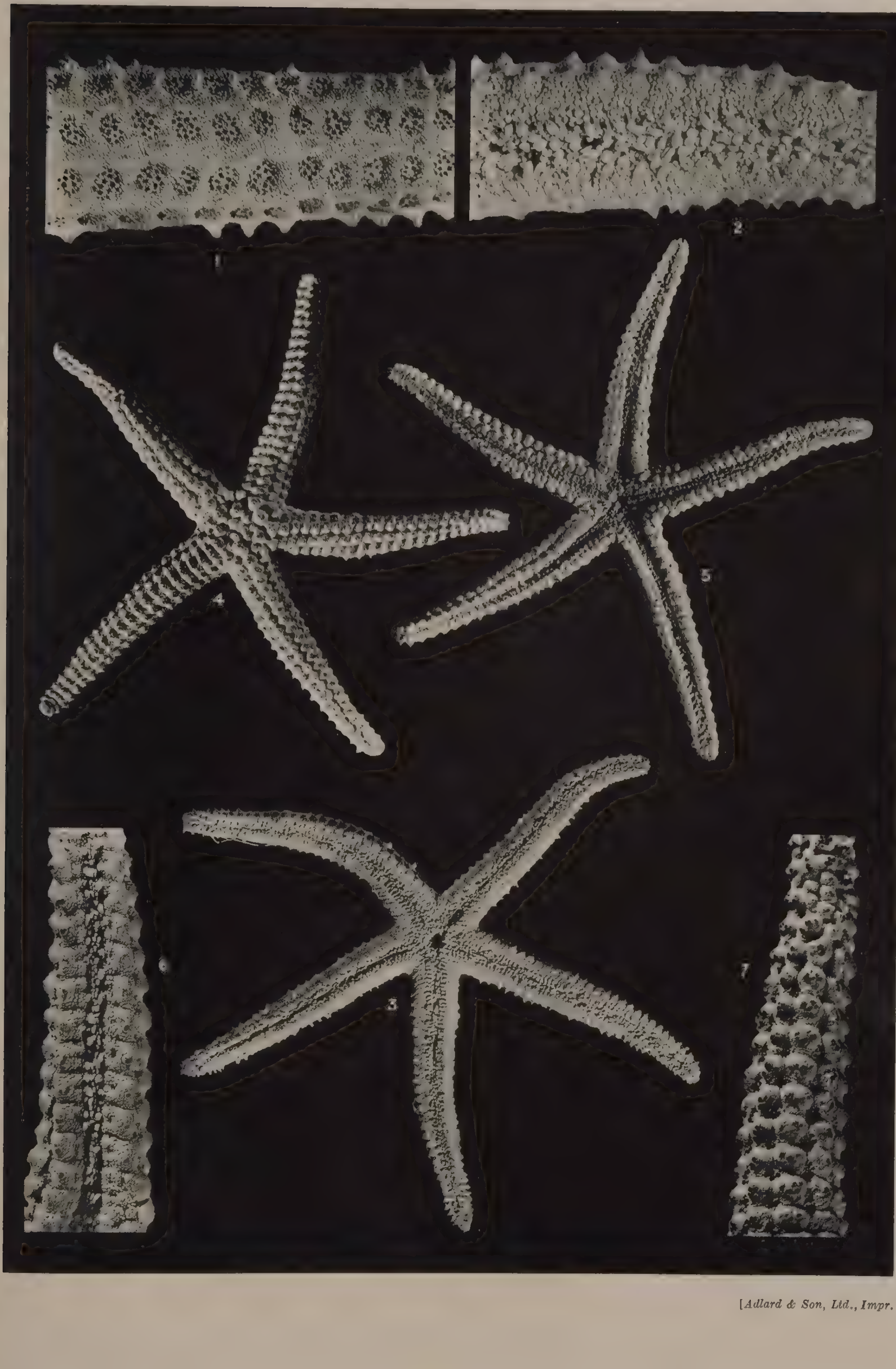
FIG. 4.—*Tamaria fusca*, Gray. Abactinal view of Gray's holotype (Brit. Mus. Coll.). (× 1½.)

FIG. 5.—*Tamaria fusca*, Gray. Actinal view of Gray's holotype. (× 1½.)

FIG. 6.—*Tamaria fusca*, Gray. Portion of actinal surface of ray of Gray's holotype. (× 4.)

FIG. 7.—*Tamaria fusca*, Gray. Portion of abactinal surface of ray of Gray's holotype. (× 4.)

PLATE IX.



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DESCRIPTION OF PLATE X.

FIG. 1.—*Oreaster australis*, Lütken. Abactinal view of old adult specimen (R. = 111 mm.). (Slightly over half nat. size.)

FIG. 2.—*Oreaster australis*, Lütken. Abactinal view of smallest young adult specimen (R. = 78 mm.). (Slightly under nat. size.)

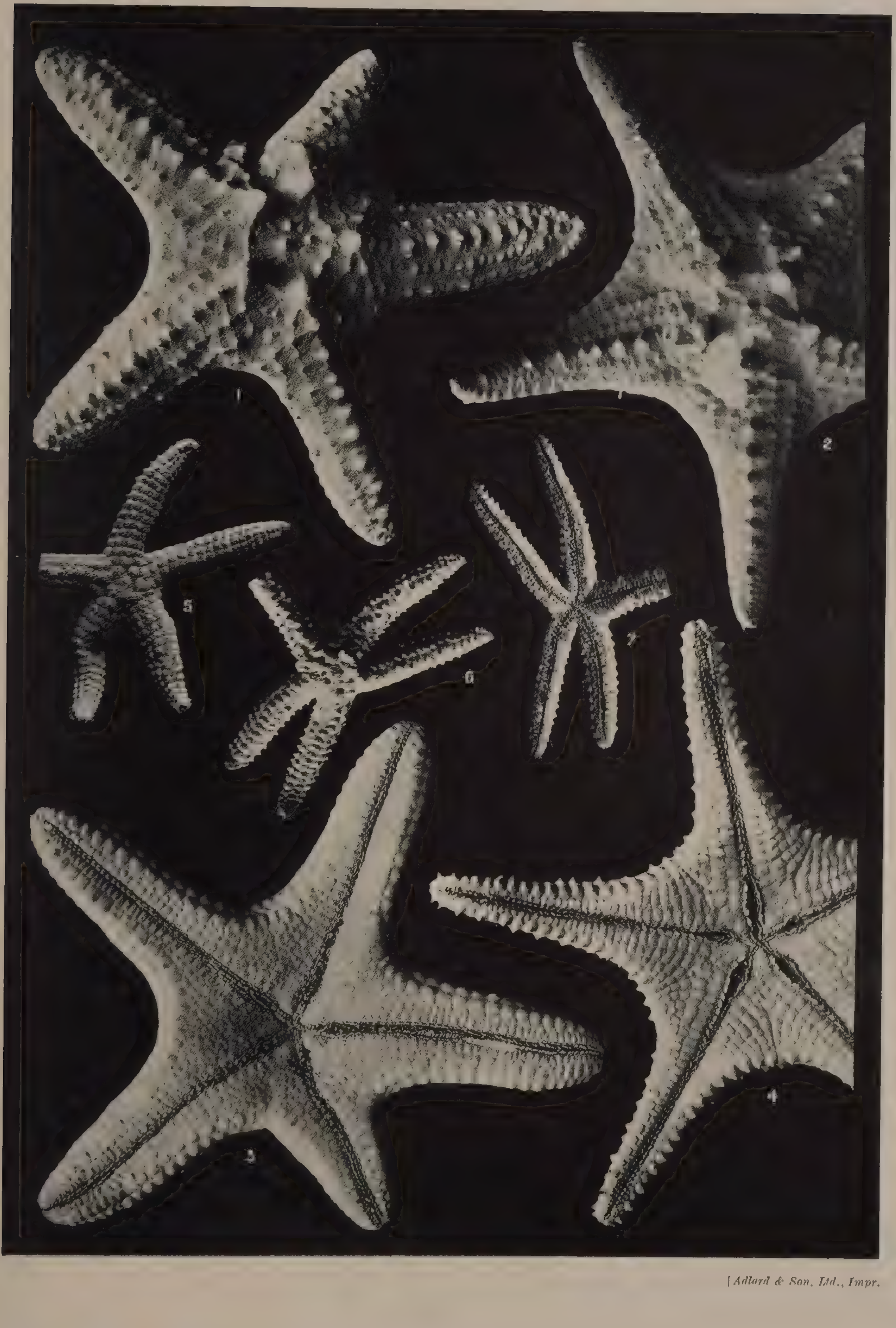
FIG. 3.—*Oreaster australis*, Lütken. Actinal view of old adult specimen (R. = 111 mm.). (Slightly over half nat. size.)

FIG. 4.—*Oreaster australis*, Lütken. Largest young adult specimen (R. = 91 mm.). (About two-thirds nat. size.)

FIG. 5.—*Tamaria hirsuta* (Koehler). Abactinal view of one of Studer's "Gazelle" specimens from north-west Australia which he identified as *O. fuscus*, Gray. It was also referred to by H. L. Clark under the name of *Tamaria fusca*, Gray (R. = about 21 mm.) (Mus. Comp. Zool. Coll.). (About × 1½.)

FIG. 6.—*Tamaria hirsuta* (Koehler). Abactinal view of an Australian Museum specimen from Western Australia which is identical with the "Gazelle" series (R. = 26 mm.). (Slightly over nat. size.)

FIG. 7.—*Tamaria hirsuta* (Koehler). Actinal view of same specimen (R. = 26 mm.). (Slightly over nat. size.)



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DESCRIPTION OF PLATE XI.

FIG. 1.—*Tamaria fusca*, Gray. Actinal view of juvenile specimen from Station XIV (R. = 7 mm.). (About × 4.)

FIG. 2.—*Tamaria fusca*, Gray. Abactinal view of same specimen. (About × 4.)

FIG. 3.—*Tamaria fusca*, Gray. Abactinal view of specimen from Station XVI showing the developing characters of the adult (R. = 15·5 mm.). (Slightly over × 2.)

FIG. 4.—*Tamaria fusca*, Gray. Actinal view of same specimen. (Slightly over × 2.)

FIG. 5.—*Tamaria*, sp. ?. Actinal view of specimen from Port Curtis, Queensland (Austr. Mus. Coll.) (R. = 103·5 mm.). (About two-thirds nat. size.)

FIG. 6.—*Tamaria*, sp. ?. Abactinal view of same specimen. (About two-thirds nat. size.)

FIG. 7.—*Tamaria*, sp. ?. (? *Linckia marmorata*, Simpson and Rudmose-Brown [*non* Mich.] [in part]). Actinal view of a specimen from Zanzibar in the British Museum (Natural History), and labelled by Bell "*Ophidiaster fuscus.*" (Nat. size.)

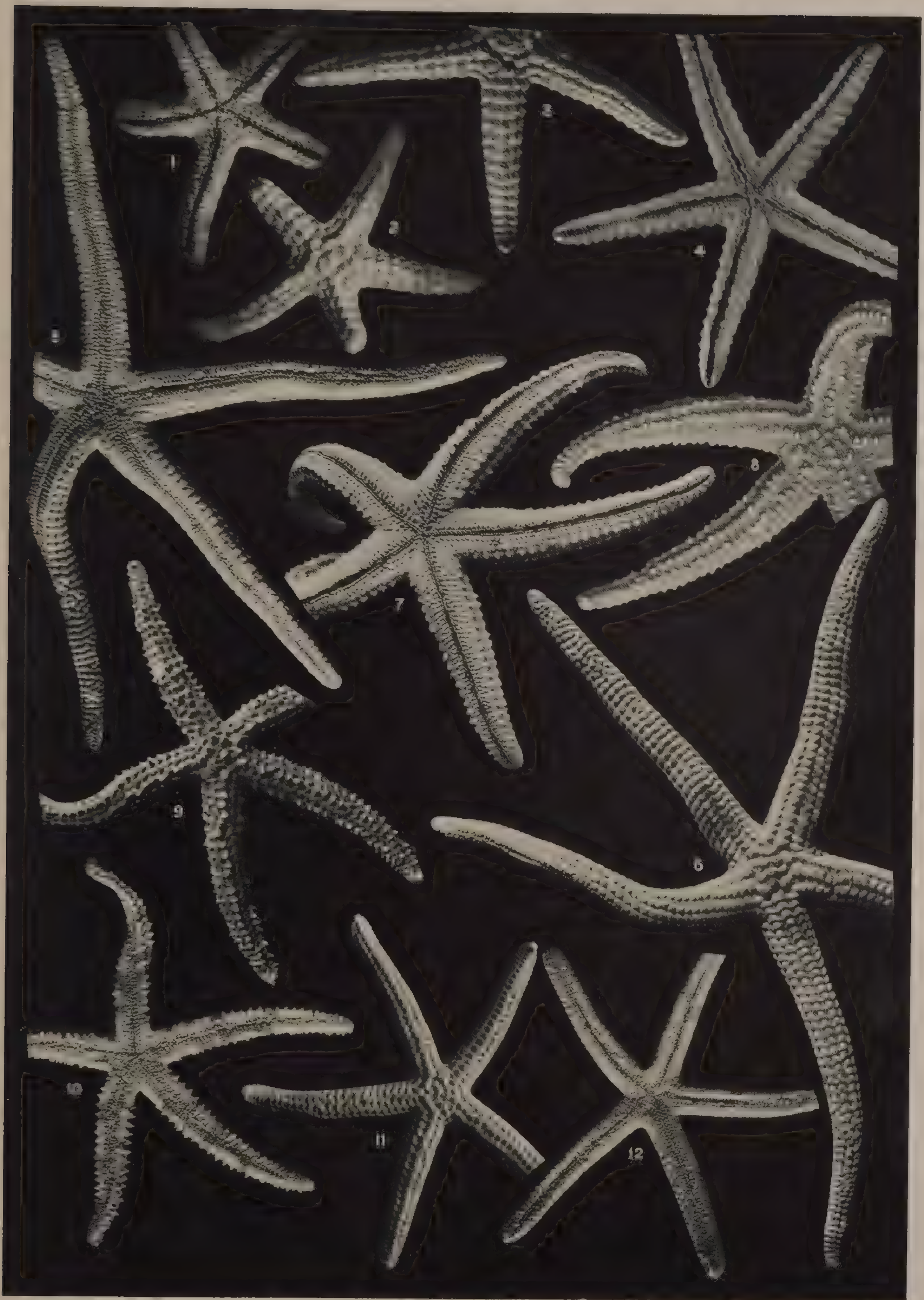
FIG. 8.—*Tamaria*, sp. ?. Abactinal view of same specimen. (Nat. size.)

FIG. 9.—*Tamaria hirsuta* (Koehler). Abactinal view of specimen from Holothuria Bank (Mus. Comp. Zool. Coll.), labelled by Bell as "*Linckia megaloplax*," and referred to by H. L. Clark under *Tamaria fusca*, Gray (R. = 44 mm.). (Slightly under nat. size.)

FIG. 10.—*Tamaria hirsuta* (Koehler). Actinal view of same specimen. (Slightly under nat. size.)

FIG. 11.—*Tamaria*, sp. ?. Abactinal view of specimen from Port Curtis, Queensland (Austr. Mus. Coll.) (R. = 34 mm.). (About nat. size.)

FIG. 12.—*Tamaria*, sp. ?. Actinal view of same specimen. (About nat. size.)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DESCRIPTION OF PLATE XII.

FIG. 1.—*Tamaria fusca*, Gray. Abactinal view of portion of ray. Specimen from Station XIV (R. = 7 mm.). (× 15.)

FIG. 2.—*Tamaria ornata* (Koehler). Abactinal view of portion of ray. Specimen was labelled by Bell as *megaloplax*, and reduced to the synonymy of *fusca* by H. L. Clark (1921). Specimen from Holothuria Bank (R. = 22 mm.) (Mus. Comp. Zool. Coll.). (× 7.)

FIG. 3.—*Tamaria*, sp. ?. Portion of abactinal surface of ray of specimen from Port Curtis, Queensland (R. = 34 mm.). (× 10.)

FIG. 4.—*Tamaria*, sp. ? (? *Linckia marmorata*, Simpson and Rudmose-Brown [*non* Mich.] [in part]). Portion of actinal surface of ray of specimen from Zanzibar in the British Museum (Nat. Hist.), and labelled by Bell as " *Ophidiaster fuscus*." (× 4.)

FIG. 5.—*Ophidiaster propinquus*, sp. nov. Actinal view of holotype (R. = 26·5 mm.). (× 1½.)

FIG. 6.—*Tamaria*, sp. ?. Same specimen as fig. 4. Portion of abactinal surface. (× 4.)

FIG. 7.—*Tamaria fusca*, Gray. Actinal view of specimen from Port Denison, Queensland (R. = 30·5 mm.). (Austr. Mus. Coll.). (Slightly over nat. size.)

FIG. 8.—*Tamaria megaloplax* (Bell). Abactinal view of Bell's " Alert " Albany Island specimen. Specimen regarded as holotype. (Brit. Mus. Coll.). (Nat. size.)

FIG. 9.—*Tamaria*, sp. ?. Abactinal view of specimen from Fitzroy Island, Queensland, 12 fathoms (Austr. Mus. Coll.) (R. = 29 mm.). (Slightly over nat. size.)

FIG. 10.—*Tamaria fusca*, Gray. Portion of abactinal surface of disc and ray of specimen from Station XVI (R. = 15·5 mm.). (× 6.)

FIG. 11.—*Ophidiaster propinquus*, sp. nov. Abactinal view of holotype (R. = 26·5 mm.). (× 1½.)

FIG. 12.—*Tamaria megaloplax* (Bell). Abactinal view of specimen from Station XXII (R. = 31·5 mm.). (Slightly under × 1½.)

FIG. 13.—*Tamaria*, sp. ?. Same specimen as fig. 9. Actinal view. (Slightly over nat. size.)

FIG. 14.—*Tamaria megaloplax* (Bell). Same specimen as fig. 12. Actinal view. (Slightly under × 1½.)

FIG. 15.—*Tamaria fusca*, Gray. Same specimen as fig. 7. Abactinal view. (Slightly over nat. size.)

FIG. 16.—*Ophidiaster propinquus*, sp. nov. Granulation of abactinal surface of ray of holotype (R. = 26·5 mm.). (× 7.)

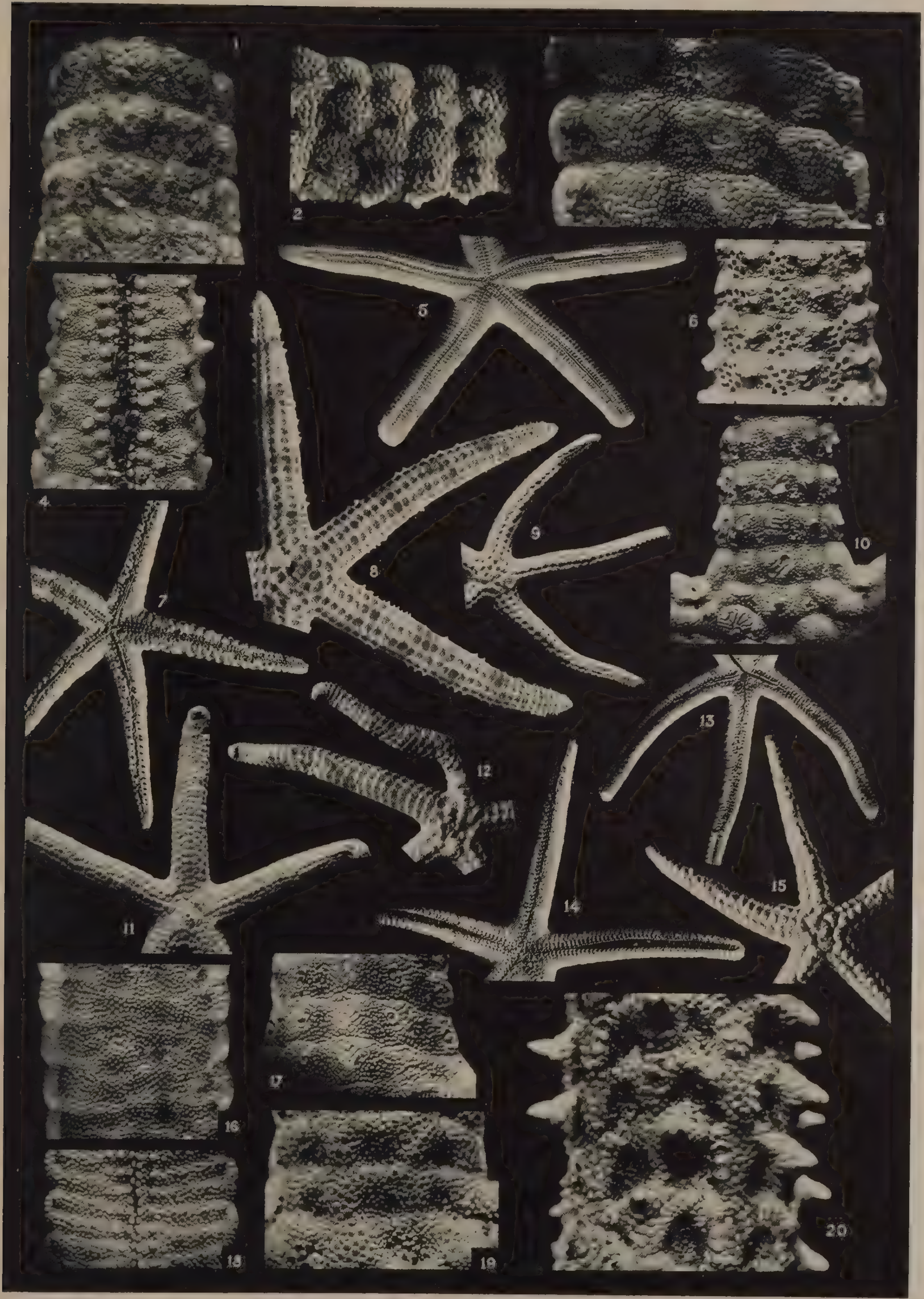
FIG. 17.—*Tamaria fusca*, Gray. Granulation of abactinal surface of ray. Same specimen as figs. 7 and 15. (About × 6.)

FIG. 18.—*Ophidiaster propinquus*, sp. nov. Granulation of actinal surface of ray of holotype. (About × 7.)

FIG. 19.—*Tamaria fusca*, Gray. Portion of abactinal surface of ray and disc. Same specimen as figs. 7 and 15. (About × 6.)

FIG. 20.—*Tamaria hirsuta* (Koehler). Portion of abactinal surface of ray of Holothuria Bank specimen labelled by Bell as " *Linckia megaloplax* " and referred to by H. L. Clark (1921) under *T. fusca* (Mus. Comp. Zool. Coll.) (R. = 44 mm.). (× 7.)

PLATE XII.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